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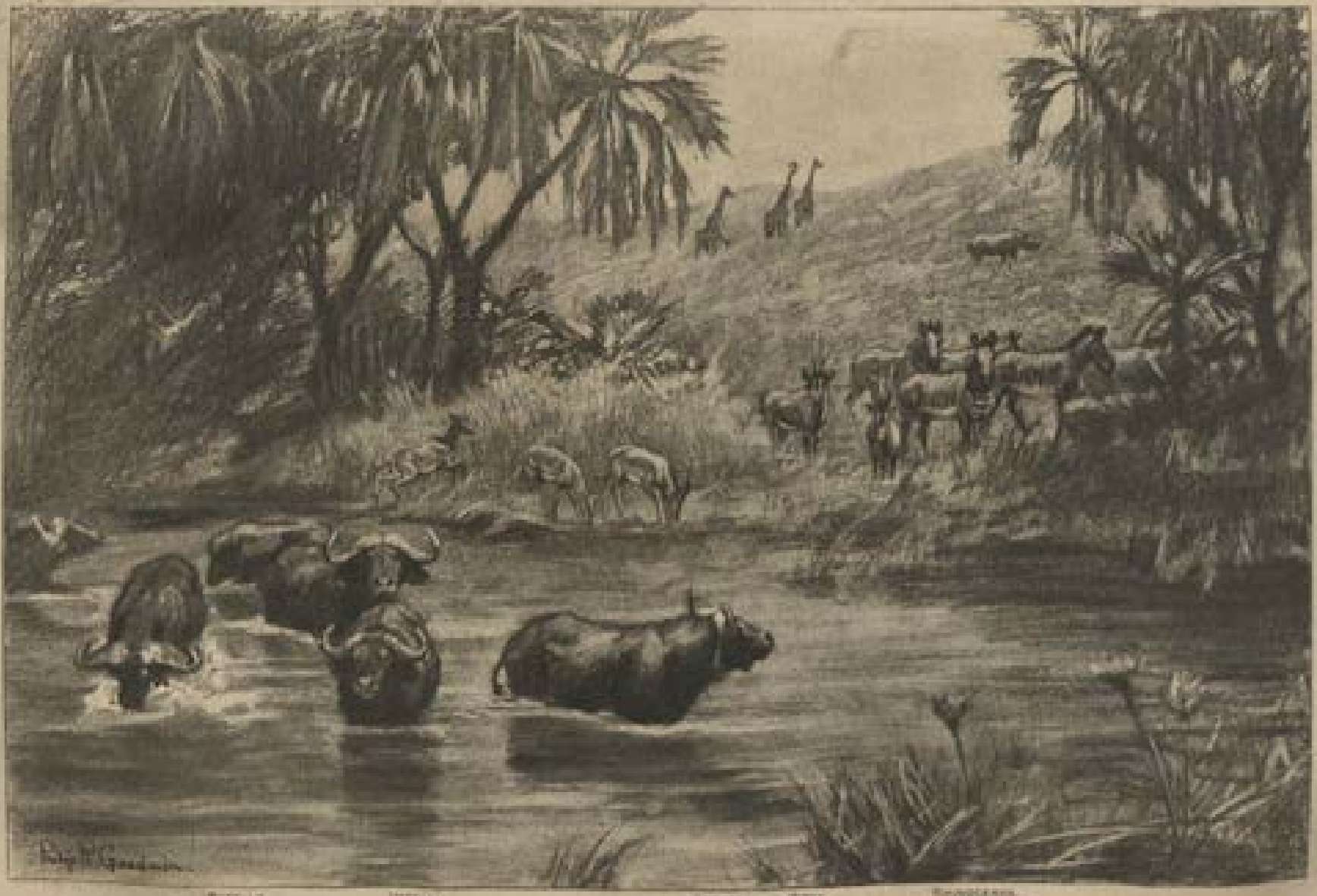

On the Northern Zouga Nyassa River

From a drawing by [illegible]

LIFE-HISTORIES OF AFRICAN GAME ANIMALS

55306

BY THEODORE ROOSEVELT
AND EDMUND HELLER

2975

WITH ILLUSTRATIONS FROM PHOTOGRAPHS, AND FROM DRAWINGS BY PHILIP R. GOODWIN; AND WITH FORTY FAUNAL MAPS

VOLUME I

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TO

CHARLES D. WALCOTT

SECRETARY OF THE SMITHSONIAN INSTITUTION

PREFACE

THE life-histories of African game mammals offer an almost virgin field for investigation and study. The present treatise is a faithful account of what we have ourselves observed; it sets forth much of what is now known; but its real value must lie in its being treated primarily as a suggestion of what is still open for discovery in this vast field of animal psychology and adjustment to environment. The discovery of new species and races based upon the study of preserved specimens of game animals, has already progressed very far; but the more attractive field which includes the habits of the game remains yet to a great extent unexplored. This field is peculiarly open for investigation to big-game hunters, and to all other men who go far afield and obtain first-hand knowledge of the conditions under which the game animals live. The closet naturalist, with his technical knowledge of the structure of animals, can be trusted to perform the work of classification to a mathematical degree of precision; but we cannot obtain from him a trustworthy account of the behavior of animals in their natural environment, or learn from him the value to the animals of the various structures or characteristics which he has shown them to possess. Much knowledge regarding the habits of game is acquired by the successful sportsman. Yet it is often infinitesimal in quantity compared to what

may be acquired if the outdoors observer will direct his investigations along the broad lines covering the life-history of the species with which he comes in contact. To carry out such investigations successfully it would be necessary to spend many hours and days, perhaps even weeks and months, observing certain individuals or family groups of game. This is quite beyond the limits of time alloted the average sportsman. Nevertheless much can be learned by the collected evidence from many fragmentary observations, providing only these are accurate. A great mass of accurate fragmentary observations will often spell far more progress in investigations of this kind than the observations of a few trained individuals over an extended period of time.

The specimens of game animals most familiar to the writers are those secured by the Smithsonian African expedition under the direction of Colonel Roosevelt, which are now preserved in the National Museum at Washington. This collection consists of some six hundred specimens of big-game mammals from British East Africa and the upper Nile regions, comprising more than seventy species or races, nearly all of which are represented by series of various ages and sexes. Besides this collection, Edmund Heller has examined at the National Museum the Paul J. Rainey collection from British East Africa consisting of some four hundred specimens of big game, the Abbott collection from Kilimanjaro, the Carl Akeley collection from British East Africa in the Field Museum, the Tjader collection in the American Museum of Natural History, the British Museum collections, the Powell-Cotton collection from northern Uganda and Mount Elgon, the Berlin Museum collection, the Congo Museum collection at Brussels, the Paris Museum

of Natural History collection, and a considerable number of smaller collections of game animals.

The country traversed by the writers jointly during their association on the Smithsonian African expedition in 1909–1910 covered the region of the Athi Plains north to Machakos and westward to Nairobi, thence from Kijabe southwest to the Loita Plains or Sotik district and northeast to Lake Naivasha. From this point a journey was taken over the summit of the Aberdare Range through Nyeri to the southwest slopes of Mount Kenia. Returning to Nyeri the journey was continued northeast, skirting the slopes of Kenia to its northeast base at Meru. A further expedition was made from Meru northward to the Northern Guaso Nyiro River, continuing up country along its course and across the Laikipia Plains to Nyeri and thence to Naivasha. A journey into the Uasin Gishu country was made from the summit of the Mau Escarpment at Londiani northwest to Sirgoit Lake and the headwaters of the 'Nzoia River. After returning from the Uasin Gishu Plateau the journey was continued westward by way of a steamer across the Victoria Nyanza to Entebbe and Kampala, and thence by way of Hoima to Butiaba on the northeast shore of the Albert Nyanza. Embarking at this point in boats the route led down the Nile to Rhino Camp near the present site of Wadelai, but upon the opposite or west bank of the river. From Rhino Camp the voyage was continued after an interval to Nimule and thence overland to Gondokoro. A trip was made westward of Rejaf. Here the voyage was farther continued down the Nile to Lake No at the entrance of the Bahr el Ghazal and thence to Khartoum, where the natural history operations were discontinued. This journey covered a period of eleven

months' field work, almost every day of which was devoted to active operations. More recently, in 1911 and 1912, Edmund Heller again traversed much of the same highland country in British East Africa with Paul J. Rainey. In addition to the regions previously visited he journeyed into the desert district lying between the Northern Guaso Nyiro River and Mount Marsabit and also visited the coast districts of Mazeras, Maji ya Chumvi, and the Taita Hills and the inland districts in the Kakumega forest south of Mount Elgon. Previously to these two journeys he accompanied Carl Akeley to British East Africa in 1905, visiting the highland region about the Athi Plains, Lake Naivasha, and Molo on the summit of the Mau Escarpment, in addition to the lowland districts near Voi.

At present we know so little regarding the habits and life-history of the various game animals that we find ourselves at a loss to account for many of their most obvious peculiarities. For instance, the distribution of almost any game animal offers some features which with our present knowledge are inexplicable. It is well known that every animal, or plant for that matter, has strongly within it the tendency to enlarge its distributional area until it covers the habitable earth. It is equally well known, although not so universally kept in mind, that the distribution of each species marks the limits within which it is able successfully to compete with its environment. It would appear, therefore, a comparatively easy matter to determine the factors which are accountable for the distribution of any species; and yet no task in natural history is more difficult.

This is one of the fields open to sportsman and to traveller alike. Dozens of factors enter into each case; and

no two cases are quite alike, each species being largely a law unto itself. Generalizations concerning habits and distribution are accordingly very difficult to prove true until much investigation has been undertaken concerning all the species or groups concerned. The distribution of one species may depend upon the distribution of its food plants or animals, of another upon its natural enemies, of another upon climatic conditions; while yet others may be limited in distribution only by natural boundaries such as large bodies of water or high mountains. Usually the factors consist of a combination of some of these or all of them acting in varying degrees.

Again, take the question of the extent to which an animal is nocturnal. In our observations on African game we were not able to make out whether or not under natural conditions some of the antelopes were more nocturnal than others. But in American game this is certainly the case. The whitetail deer will often feed at all hours of the night, as we can personally testify, and this when there is no moon. But Mr. Shiras informs us that moose do not feed—at least by the water's edge—later than ten or eleven at night; whereas the whitetail will continue feeding until dawn. Caribou are diurnal. Wapiti feed freely in moonlight, but move about very little on moonless nights. Blacktail move about more freely on dark nights than wapiti, but hardly as freely as whitetail.

The chief purpose of the present publication is to give our own observations, and in some cases to add what is already known, regarding the life-histories of African game animals, so that sportsmen who combine love of hunting with a taste for faunal natural history, and outdoor ob-

servers of all kinds, may direct their efforts along new lines of investigation and toward a more complete understanding of the life-histories of the various species.

In dealing with the systematic side of the work the authors have kept in mind the desirability of keeping the recognition of races well within the powers of discrimination possessed by the average non-scientific outdoors man, whether sportsman, explorer, or nature lover. Some descriptive naturalists have recently proposed distinctive names for new races of game mammals based upon very slight characters in color or form, differences which can scarcely be detected by an expert, much less by a layman. In still another and even more numerous class of cases, the supposedly distinct species or races are based upon individual differences in specimens, or upon immaturity. The described races of elephant, giraffe, and buffalo are chiefly of this character. The preserved specimens of these great mammals are so few that it has been possible to describe races only from the study of individual specimens taken usually in widely remote localities and often of very different ages and even of different sexes. The comparison of material of such diverse character has in many cases led to the description of individual differences as racial. At present all the museums combined do not contain sufficient specimens representing these great mammals to make possible the exact determination of the subspecific characters of the geographical races. The difficulty of studying the largest species applies in a general way to the bulk of the big-game animals. Besides the limited number of specimens available, there are physical difficulties which often lead the species-maker astray. The mere size of the great specimens

prevents the optical comparison of form or coloration when the specimens are arranged side by side in a series, the eye being incapable of taking within its area of vision at close range more than one specimen, or part of one, at a time, so that comparison by measurements must be resorted to. The smaller mammals, on the other hand, can be compared much more minutely because a large number of them can be brought within the range of vision at the same time; and also, because of their smaller size, larger numbers of them are available in museums for study. The specimens of large mammals being limited in number, and their size being so great, minute discrimination cannot be employed in determining their characters.

A "species," as we have used it throughout the text, may be defined as the most limited collection of individuals showing some one structural or color character or combination of characters distinct from the character or characters possessed by any other group of individuals. A subspecies or race we may define as a closely related group of individuals occupying a certain portion of the area occupied by the species to which it refers, and exhibiting intermediate characters in part or in all of the individuals occupying the intermediate regions between the centre of development of the race and the centre of development of any other race of the same species. In other words, the subspecies is a geographical race linked with any other subspecies of the species to which it refers by individuals exhibiting intermediate characters. We regard degree of difference as the essential feature in the determination of species and hold that geographical isolation is not of itself of specific value if the individuals concerned show but slight, even if

constant racial characters. The giant eland inhabiting the Lado Enclave and Bahr-el-Ghazal Province is a good example of the case in point. The Nile race differs very slightly from its geographical ally which is found, as far as we know, only in the Senegal region on the West Coast of Africa and is separated from the Nile form by some two thousand miles. Although so widely isolated geographically from the Senegal eland, *Taurotragus derbianus*, the degree of difference in coloration or other characters of the Nile race is so slight that we prefer not to give it specific rank, and refer to it merely as a race *Taurotragus derbianus gigas*.

Genera we have treated in a similar way; that is, we have made degree of difference the essential feature and have grouped together only species equally related. Convenience has not been considered a determining factor, no account being taken of the number of species within the genus. A few cases of antelope genera demanding segregation in order to emphasize the relationships of their various species have come under our notice. Hunter's antelope of the Tana River is a case of this sort. This species has been taken out of the genus *Damaliscus* with which it neither agrees in horn shape nor coloration and has been placed in a new genus, *Beatragus*. The genus *Kobus* as generally used is a further instance of a similar sort. Three groups of not especially close relationship and all of wide distribution over Africa have been associated together. This genus is now split into: *Kobus*, the waterbucks of large size with wide-spreading, slightly recurved horns and shaggy-haired bodies; *Adenota*, the kobs of small size with s-shaped horns and short-haired bodies; and, finally, *Onotragus*, the lech-

more widely separated than the horse from the ass, are fertile *inter se*.

It must be understood, therefore, that "species" is as purely a term of convenience as "genus." It designates all the animals of a certain type which it is convenient to group together under one name, both to indicate their more or less close relationship to one another, and their greater or smaller dissimilarity from other forms. As the term is one of convenience and should indicate relationship, it is well not to over-refine it in using it on ordinary occasions—that is, not to become a species-splitter—and, as far as possible, to use it so that there may be some rough approximation between what is meant by species in one case and in another. In technical scientific treatises the use merely of generic and specific terms may not be sufficient to indicate the finer differences; in such event it is unwise to make a fetich of binomial Latin terminology—in itself also a pure convenience—and it is well to use freely a trinomial, or quadrinomial or pentanomial terminology. But in ordinary writing, not only for scientific laymen, but for intelligent laymen of all kinds, and also for scientists not so much absorbed in details as to lose sight of the importance of the whole, it is well to use the word "species" in as large, as ample, a sense as possible. Any needed further definition can be made by the use of such words as subspecies, varieties, geographical races, and the like.

Mr. George Shiras, out of his own experience, recently supplied a case in point. Mr. Shiras, although he would disclaim the title, is a faunal naturalist whose photographs of and notes on the big game and various other mammals and various birds of the North American wildernesses are

of unique value. He is a singularly competent observer. Recently he was speaking of his first trip to Alaska and how he had been interested in reading about the "Alaskan jay" —only to find it, as he expressed it, "the same old whiskey-jack," identical in every essential with the familiar whiskey-jacks of the woods of Maine, Canada, Michigan, and the Rocky Mountains. He said that he knew the blue jay, the Florida jay, the big-crested jay of the Rockies, all obviously distinct species; and he knew the whiskey-jack, or Canada jay, also as a separate species; but that to write about a local variety of the latter as the "Alaskan jay" as if it were a separate species in the sense that is true of the Florida jay, or blue jay, or Steller's long-crested jay, merely served to confuse him—that is, to confuse an intelligent, outdoors layman-naturalist, a keen observer. Mr. Shiras is emphatically right in his complaint. Give the Alaskan form of the whiskey-jack a third Latin name, by all means, to distinguish him in writing treatises exclusively for specialists —if it gratifies them; but in books for general reading by intelligent men call it the whiskey-jack, mentioning only if necessary that the allusion is to the Alaskan form.

Let us illustrate what we mean by using as examples the big cats: the lion, tiger, cougar, jaguar, and leopard. These represent five very distinct animals. The last two come closer together than is the case with any of the others, but even as regards these the distinction is obvious. The use of the word species as regards each of these big cats conveys a definite, graphic, and easily grasped idea, which corresponds to the facts in the case. But each is split into various forms. The cougars of Brazil, Patagonia, the Andes, Colorado, Oregon, and Florida all differ from one another,

and all have been made into species, the Latin names of which convey no intimation that they do not differ from one another as much as all collectively do from the lion, tiger, or leopard. We think such a system of nomenclature a mistake, even from the standpoint of the pure specialists. It is a case for trinomial Latin nomenclature; call the animals all *Felis concolor* (or *Felis puma*, or by whatever name the last delver into the bibliography of the subject has discovered was the first name mentioned in some obscure book a century ago), and add *hippolestes*, or *oregonensis*, or whatever other title is necessary to show what particular regional form is meant. Follow the same course with the tiger and the lion. Then we shall treat, as we ought to, of the big cats as lions, tigers, cougars, leopards, and can add in each case where it is necessary the limiting adjectives—Manchurian tiger, Masai lion, Patagonian puma—without encumbering ourselves with such an elaborate and minutely divided terminology as serves merely for the darkening of wisdom.

It would be well for ordinary purposes to adopt somewhat similar treatment for the word genus. It is an excellent word when used to indicate both the resemblances of different animals and their common differences from other somewhat similar groups. It is highly desirable to include only closely related forms in each genus. But if too much split it loses much of its value. To make one genus of lions, another of tigers, another of leopards, is to rob the word genus of much of its value. Exactly as with species, it is wise to remember that genus is a pure term of convenience. In scientific treatises written by specialists for a limited number of other specialists, there is no possible reason for

not using Latin names which will indicate genus, subgenus, species, subspecies, and variety, if great exactness in the conveyance of the idea is needed; there is, as we have already said, nothing sacred in the use of Latin binomial terminology. But in ordinary scientific writing for laymen—when we say scientific writing for laymen, we mean the kind of writing which found its highest expression in the works of such masters of science as Darwin and Huxley—it is better to use terminology which is fairly clear and fairly easy to understand. This does not mean that we can revert to the Linnæan genera and species; but it does mean that we can try to use genera and species in somewhat the same sense as Linnæus used them, of course keeping in view the enormous mass of information which has been accumulated since the great Swedish naturalist first reduced biology from chaos to system.

In order to define the species more clearly we have made all the geographical forms of subspecific rank by taking the first described one as the typical race and repeating the specific name. The first known form of any specific group is necessarily originally described as a species, but later, upon the recognition of additional races, the original must be reduced so as not to confuse our conception of the species. The Grant gazelle, for instance, was originally described as *Gazella granti* from Ugogo in German East Africa, and for a considerable number of years this remained the only form described and the original locality the only place from which it was known. Later, upon the exploration of East Africa by sportsmen, many specimens were collected in various parts of the country and gradually the various races we now recognize were described, as our

knowledge, based upon the accumulation of specimens, advanced. The original locality thus becomes the home of the typical or first-described race, *Gazella granti granti*, and the other described races, such as *robertsi*, *brighti*, *notata*, *roosevelti*, etc., occupy adjacent districts, and these areas as a whole represent the range of the species or Grant gazelle in its entirety.

Considerable difficulty has been encountered in mapping the ranges of the various species and races owing to the vastness of the area covered and the lack of records for many of the species over much of the area. The distribution of the game animals in the territory through which the writers have travelled, particularly that of the highland region of British East Africa, is well known, but beyond this territory the distribution in a detailed way is unknown, and it has been necessary to map it somewhat approximately. The actual spots from which specimens have been collected or recorded are marked on the maps by numerals referring to each species and race, and these represent faithfully the real data upon which the mapped areas are based. The interest in the large game mammals in equatorial Africa is so keen among sportsmen that at the present time their distribution is better known than any other group of animals to be found in the same territory. Owing to the present fairly satisfactory state of our knowledge of the distribution of the game animals it has been thought worth while to attempt to show their ranges by means of maps. It is hoped that these maps will lead to a clearer understanding of the distribution, and form a basis upon which to build in greater detail. In cases where the data have been insufficient or where a single

form is considered no map has been prepared showing the ranges of such species and races.

The sportsmen who have shot and written about East African game animals have come largely from temperate Europe or North America, and have to a considerable degree looked upon the African game animals in the light of their knowledge of northern species. In this way they have often come to regard differences in coloration between individuals of the same species as seasonal affairs, one coat being attributed to the summer season and another to the winter. As a matter of fact, however, the mammals of equatorial Africa have no definite season for shedding their coats nor are they subject to any seasonal climatic change which would necessitate such a change. The climate over the greater part of the highlands is uniform or so irregular that no definite seasons can be said to prevail. On the coast and in the lower desert districts flanking the coast a more definite climatic division into dry and rainy season exists, but the rainy seasons are usually two annually, and so short that a mammal cannot adjust its pelage to the change. In some species there is a great individual variation in coloration, as in the case of the male white-eared kob and Nile lechwi, in which a large per cent of the individuals become black in adult life, but such changes are never seasonal. Similarly erroneous ideas regarding a definite breeding season in East Africa for large mammals are quite prevalent among sportsmen, but there is no climatic necessity for such a habit. Young of almost all ages can be seen at the same season throughout the highlands, but there does seem to be in some species a certain time when the young are born in greater numbers. In

the coast district and the low country, where the rain seasons are well marked, there may be a more defini breeding-season, but upon this point we have no exa knowledge, owing to the difficulties of observing gam animals in such bushy districts and the lack of data refe ring to such districts.

In the preparation of the present work Colonel Roose velt has written the first draughts of the life-history accoun under each species, and of the introductory chapters o Game Reserves and on Concealing Coloration. Mr. Helle has prepared the first draughts of the other introductor chapters, and of the technical descriptions (including th nomenclature used, the coloration, and the faunal map showing the range of each species). But each has reviewed added to, and assented to the work of the other; and thei responsibility for the entire book is joint.

The Secretary of the Smithsonian Institution, Docto Charles D. Walcott, has kindly permitted the mamma material in the National Museum to be drawn on freely fo study and description, and the data derived from this source have been of invaluable assistance.

The photographs which have furnished the illustrations have been received from various sources. Many of those taken from life in East Africa and Uganda have been supplied by Carl E. Akeley. Doctor William T. Hornaday has donated for use a large number of photographs of the African animals in the New York Zoological Park under his charge. By far the larger number of photographs of heads of game animals have been received from James L. Clark and represent heads mounted in his studio in New York. The groups and mounted specimens in the United States

ational Museum have also furnished numerous illustrations, as well as the specimens of live animals from British East Africa donated by William N. McMillan to the National Zoological Park. For the photographs of the McMillan mammals we are indebted to Mr. A. B. Baker, assistant superintendent of the park. The Field Museum of Chicago has supplied the photographs of the unmounted groups of Somali mammals mounted by Carl E. Akeley in that institution. To all of these the writers wish to acknowledge their indebtedness.

THEODORE ROOSEVELT,
EDMUND HELLER.

NEW YORK, *October* 1, 1913.

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*** The numerals **1**, **2**, **3**, etc., on the maps mark the exact spots where specimens have been collected or observed by reputable sportsmen, and the lines limiting the distribution are drawn around these numerals so as to map the approximate area occupied by the race to which the numeral refers.

⊙ Represents type locality or exact spot from which the type or original specimen came.

LIFE-HISTORIES
OF
AFRICAN GAME ANIMALS

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CHAPTER I

THE COUNTRY AND ITS HISTORY

The establishment of British protection over East Africa and Uganda is of very recent birth, dating back scarcely over a score of years. The history of the inland exploration of the country is very little older. Only within the last half century have we learned the more important details of the topography of the interior, the position of the great equatorial lakes and their connection with the Nile watershed. It is indeed difficult to realize that a coast which has been known to Europe since the fifteenth century could hide from civilization for three centuries and a half all knowledge of its hinterland. Ptolemy's map, in the middle of the second century, actually gives a better idea of this hinterland than that given by the European maps of the middle of the nineteenth century.

The Portuguese navigator Vasco da Gama was the first European to visit the coast. In 1493, during his circumnavigation of Africa, he touched at Mombasa and Malindi, and later carried to Europe the first knowledge concerning the East Coast. Mombasa and the neighbor-

ing coast for the following two hundred years was subject to the control of various peoples. Sovereignty fluctuated at various times between Portuguese, Turks, Arabs, and negro tribes. Throughout much of this long period, during which the country remained unknown, the seaports were at war with civilized powers or besieged by the tribes living near the coast and were effectually prevented from sending any trading or exploring caravans into the wilderness. One of the most powerful deterrents to inland travel were the fierce Masai, who harassed and controlled the interior highlands. The occasional looting of the coast districts by wandering bands of Masai kept the tribes who were in touch with civilization in mortal fear of these savage warriors.

The first Englishman to reach the coast was Commodore Blankett, who touched at the mouth of the Juba River in 1799, where a landing party from his fleet were treacherously murdered by the natives. After this incident he sailed southward to the island of Zanzibar, where his fleet was well received. A half century later, in 1844, a German missionary, Ludwig Krapf, recently expelled from Abyssinia, entered Mombasa and established the first Christian mission. A year later he was joined by another German missionary, John Rebmann, who founded a second mission a few miles inland, among the Warabai tribe. Rebmann, with a few native followers, and armed only with the faith he represented, penetrated inland in 1848 and discovered the giant snow-capped mountain of Kilimanjaro, journeying to within fifteen miles of the great volcano. The dome or crater attains a height of nineteen thousand seven hundred feet and can be seen from a few score miles

inland, although situated some one hundred and seventy miles from the coast.

The following year Ludwig Krapf made a longer journey inland and discovered Mount Kenia, the second highest mountain on the continent of Africa. Kenia is situated two hundred and fifty miles from the coast and attains an altitude of seventeen thousand feet. Krapf did not reach the mountain, but saw the peak from a distance of forty miles from the Kitui district southeast of the peak.

The first Arab caravan to brave the perils of the far interior and cross the much-dreaded Masai and Nandi country reached the Kavirondo district in 1857. Within a few days' march of the shores of the Victoria Nyanza they were stopped by the authority of the King of Uganda from entering the country under his control, but they learned from the natives of the existence a short distance westward of a great body of water. During this year Speke, after leaving Burton at Lake Tanganyika, which they had just discovered, journeyed northward alone and reached the southern shore of the great Nyanza.

Upon his return to England he organized an expedition to further explore the vicinity of this newly discovered lake, which he had shrewdly guessed formed the headwaters of the Nile. With Grant he set out in 1862 across German East Africa and eventually reached the lake. They skirted the western coast to the vicinity of Kampala, where they obtained guides from the King of Uganda, who led them to the Ripon Falls where the Nile issues as a cataract from the great lake. Speke and Grant, however, did not trace the Nile from its birth at the Ripon Falls westward to the second lake, the Albert Nyanza. Owing to

the difficulties or danger from native attack in the region traversed by the Victoria Nile, the explorers chose a route westward through the central portion of Unyoro and thence northwest across the Victoria Nile to the Bahr el Jebel or upper Nile. They thus missed by a few miles the discovery of the Albert Nyanza of which the natives had given them accounts. On their journey down the Nile they met at Gondokoro Sir Samuel Baker who was ascending the river on a mission of discovery concerning its source. He received from Speke and Grant information concerning their discoveries and of the native reports of another large lake on the borders of western Unyoro. Baker soon afterward, in 1864, ascended the Nile and discovered this lake which he named the Albert Nyanza. The amount of natural-history material brought to Europe by Speke and Grant is really marvellous considering the limited means of transportation at their disposal and the great length of their journey. They brought collections of mammals, birds, reptiles, fishes, insects, and plants, accompanied by extensive field notes.

Subsequent explorers of the same district for the following thirty years failed to equal these initial efforts to give to the world a knowledge of the fauna and flora of equatorial Africa. Stanley with the immense resources at his command is a notable example of this sort. He followed in the paths cut by these two intrepid explorers, but added very little to the discoveries made by his predecessors, and he further accumulated only an infinitesimal number of specimens or amount of information concerning the animal and plant life of the regions he visited.

Speke and Grant collected fourteen specimens of hoofed

animals. Two of these were striking new species and were named after the explorers: the sitatunga, *Limnotragus spekei*, and the great-horned gazelle, *Gazella granti*. Several other new species of big game were in the collection, notably the white-bearded wildebeest and Baker's roan antelope, but they were named later from specimens secured by more recent explorers.

While Speke and Grant were exploring Uganda, Heuglin, a German naturalist, was penetrating the unknown region of the Bahr el Ghazal, a western affluent of the White Nile. Theodore von Heuglin was more naturalist than explorer, his work being undertaken without any political or geographical incentive. He made extensive collections of the mammals, birds, and plants of the upper Nile districts during 1863–4. To this exploration is due the discovery of the giant eland, the largest of all known antelopes. The giant eland is of rare and local occurrence, and since its discovery in 1864 remained quite unknown until within the last five years, when it was rediscovered in the region where Heuglin first obtained it. He also discovered and named the lelwel hartebeest, the Nile bushbuck, and the remarkable white-withered lechwi, since called Mrs. Gray's waterbuck. This latter species he failed to fix in literature by a description, but simply gave to it a name, *Adenota megaceros*. A fellow countryman, Fitzinger, in recording the collection on its arrival at Vienna, mentioned the name proposed by Heuglin and added a short description which gives the name standing and fixes it for its discoverer. Later Gray, of the British Museum, described it as *Kobus maria*, from a specimen obtained subsequently by an English consul.

Following Speke and Grant we have a host of explorers entering equatorial Africa successively down to the present time. Doctor Georg Schweinfurth, a German botanist and anthropologist, followed in the footsteps of Heuglin in the Bahr-el-Ghazal region during 1863 to 1871. He described the region and its inhabitants and added a list of the mammals observed; but his efforts were chiefly devoted to the botany of the region. Another German, Baron von der Decken, ascended Kilimanjaro in 1862 to an altitude of ten thousand five hundred feet.

In 1875 Stanley first appeared in Uganda as an explorer. By following Speke and Grant's old route from the East Coast through German East Africa he reached the southern shores of the Victoria Nyanza. His explorations were then devoted to a circumnavigation of the lake and the mapping of its shore-line, which gave to the world the first accurate account of the lake and its approximate extent. After finishing this task he continued on through Uganda and explored the Albert Nyanza and the region southward to Lake Tanganyika. Uganda was again visited by him in 1888 by way of the Congo on the relief to Emin Pasha. No natural-history data, however, were gathered by Stanley, whose work was chiefly geographical and political.

One of the most famous of, at all events the most unique figure among, African explorers, is Emin Pasha or Edward Schnitzer, best known by his Arabic name and title. Emin was an explorer-naturalist of German-Hebrew extraction who entered the upper Nile district in 1876. He displayed remarkable administrative talents, and until 1890 reigned as governor of the Bahr-el-Ghazal Nile and the adjoining districts of the upper Congo, a post to which he was ap-

pointed by Gordon. A series of his letters relating to the political management, the people, and the fauna and flora of the region have been published, and these testify amply to his capacity as an administrator and a naturalist. At various times he made collections of the smaller mammals and birds of his provinces which he sent to the British Museum, and these formed one of the earliest sources of our knowledge of the smaller fauna of the Nile. The big-game animals seem not to have interested him. One proof of this lack of interest was his failure to report the presence of so remarkable a beast as the white rhinoceros, which was really abundant near the stations of Wadelai and Kiro, which he occupied for some time while governor.

The first naturalist to enter the territory which is now British East Africa was the German botanist Hildebrandt, who explored in 1875 the Taita district and the country northeast to the Kitui district. Besides making collections of plants, he collected the smaller mammals, reptiles, insects, and mollusks. Of the big game he collected the horns of the impalla, the common waterbuck, and the black rhinoceros. Soon afterward, in 1878, came Doctor G. A. Fischer, another German naturalist. He first visited the Tana River, which he ascended a considerable distance, discovering during the exploration the small coast race, closely allied to the Grant gazelle, known as Peters gazelle. In the forests bordering the river he collected two new species of apes, a colobus and a mangabey, neither of which have since been secured by naturalists visiting the country. Four years later, in 1882, he reached the Rift Valley and discovered Lake Naivasha. During his eight

years of travel in East Africa, Fischer collected many species of small mammals and birds.

Joseph Thomson spent the years from 1883 to 1884 in a journey of discovery through East Africa, proceeding from Mombasa westward to Kilimanjaro and northwest to Lake Naivasha. Journeying northward beyond Naivasha, he discovered the much larger lake, Baringo. From this point he travelled westward and was the first European to reach the slopes of Mount Elgon. Leaving Elgon, he continued on down the course of the 'Nzoi River to its mouth on the northeast shore of the Victoria Nyanza. During his journey he discovered the gazelle which was named for him by Doctor Günther from a few pairs of horns which he presented to the British Museum. His account of the animals met with is very meagre, but the plants which he collected during his travels received considerable attention in the narrative he published.

We owe to Sir John Willoughby the first extensive account of the game animals of East Africa. Willoughby together with Harvey and Hunter were the first men to visit the country on an expedition solely devoted to the shooting of big game. The region from Mombasa westward to the slopes of Mount Kilimanjaro was visited by Willoughby and Harvey, who reported for the first time the presence of the gerenuk and both the lesser and greater koodoo in the coast district of East Africa. Hunter made a journey up the Tana River, where he discovered the peculiar hartebeest, *Beatragus hunteri*, which has been named for him, and further reported the first occurrence of oryx, topi, and oribi in East Africa.

After the initial visit of these three sportsmen many

others entered the country on similar missions. In 1888, an American naturalist, Doctor W. L. Abbott, visited Kilimanjaro, spending more than a year on its southwestern slopes making collections of the mammals and birds of the region. To his efforts are due the discovery of a rare forest duiker, *Cephalophus spadix*, a large species related to the West African yellow-backed duiker. This species has not since been obtained by any sportsman visiting the district. He also secured the first specimens of the fringe-eared oryx and of the red forest duiker. Doctor Abbott made large collections of both mammals and birds which still remain the most extensive preserved from the region.

A year previous to Doctor Abbott's expedition Count Teleki, accompanied by Lieutenant von Höhnel, made his remarkable journey through British East Africa, travelling northward to the Abyssinian border, where he discovered a large inland sea which he named Lake Rudolf, and a smaller one northeast of it which he christened Lake Stefanie. During this expedition he made the first ascent of Mount Kenia, reaching the snow-line and naming some of the topographical features found near the summit. Later he ascended Mount Kilimanjaro to the ice cap. The trophies of big game which he preserved, however, have never been classified. We have only the account of his travels, containing a brief list of his big-game trophies and notes on his collections of plants and insects, to give us a knowledge of his discoveries.

No one has contributed more to the literature concerning east equatorial Africa than Sir Harry Johnston. This is particularly true of the natural history. He first entered the region in 1884 and made an exploration of the higher

altitudes of Kilimanjaro. The results of this expedition were published a few years later in book form. From 1899 to 1901, as special commissioner, he explored Uganda and ascended Ruwenzori. Later he published two volumes covering his own explorations in Uganda, and summarizing the work of others in the territory. This work is the most elaborate general account of the natural history extant. Johnston secured in the Uasin Gishu Plateau the first specimens of the five-horned giraffe, *Giraffa camelopardalis rothschildi*, but this race was not distinguished until several years later when the specimens collected by Powell-Cotton led to the description of the race as new. The explorations of Johnston brought to light many new species of the smaller mammals, birds, and plants.

The birth of British East Africa may be said to date from 1888, at the time of the formation of the Imperial British East Africa Company by royal charter from the British Government. For the following seven years the country was exploited commercially by the company. In 1895 the British Government took over the territory as a protectorate and the work of constructing the Uganda Railway was begun. During the tenure of the country by the company the territory was often designated Ibea, a term formed of the initials of the company. The word has since come into use in zoology as a specific term for many of the species discovered in the region.

One of the men whose name is closely associated with the early history and discovery of many of the game animals is the present governor of Uganda, Mr. F. J. Jackson. He first entered the country in 1887 on a shooting trip in the region about the slopes of Kilimanjaro. Soon after the

founding of the Imperial British East Africa Company he proceeded, in 1889, on an expedition of exploration for the company to Uganda. The old caravan route was taken from Mombasa to the Kikuyu country westward across the Rift Valley to the southern slopes of Mount Elgon and thence to Uganda. During his long residence in East Africa he has devoted much of his time to shooting expeditions, which have given him a wider experience and knowledge of the game of East Africa than that possessed by any other sportsman. In the Badminton Library, Big Game Shooting, he has given us the most comprehensive and accurate account which we have of the field natural history of the large game animals. To his zeal as a collector is due the discovery of many of the described species peculiar to East Africa. The large hartebeest, *Bubalis jacksoni*, which was named for him by Oldfield Thomas, was discovered during his first Uganda expedition. Later he discovered an allied species in central Uganda, *Bubalis insignis*. The first specimen of the bongo, a pair of horns, which reached Europe were obtained by Jackson from Wandorobo bushmen, but they were unfortunately erroneously assigned by Sclater to the nyala of South Africa. Later Isaac, for whom the species was named, obtained more complete specimens from the Wandorobo, which enabled Thomas to discover the really close affinity of this rare forest species to the West African bongo. The white-bearded wildebeest and the Kilimanjaro red duiker were further discoveries based on Jackson's collections. To his efforts are due also many discoveries of new species among the smaller mammals and birds of East Africa.

The Tana River and the desert region of East Africa were

visited in 1892 by an American sportsman, William Astor Chanler, in company with Von Höhnel, who had accompanied Count Teleki some five years previously. Chanler devoted his efforts to an exploration of the Northern Guaso Nyiro River, which he followed from the slopes of Mount Kenia to its termination in a swamp in the midst of the desert. He discovered the existence of the Lorian swamp and considered it to be the termination of the river, and independent from the Tana River system as well as the sea. During the explorations in the vicinity of Kenia he discovered the small species of rock reedbuck, *Oreodorcas chanleri*, which has been named for him.

In 1894 another American, Doctor A. Donaldson Smith, reached Lake Rudolf by a new route from the northeast, and then continued southward across the Guaso Nyiro to the Tana, and down the Tana to the sea. In addition to big-game hunting he collected some twelve hundred specimens of vertebrates, eighteen hundred insects, and three hundred plants. Six years later, in 1900, this explorer made another expedition from Somaliland west to the north end of Lake Rudolf, and thence west to the Nile, at Fort Berkeley, being the first white man to explore the region between Rudolf and the Nile.

In 1893 we find two Neumanns appearing in East Africa, one, Arthur H. Neumann, an English elephant hunter, the other, Oscar Neumann, a German naturalist. A. H. Neumann journeyed inland from Mombasa following the old caravan route to Kitui southeast of Mount Kenia. From this point he continued north, skirting the eastern flank of the great mountain, and then travelled northward to the Lorogi and Mathew Ranges, the flanks of which he followed

to the shores of Lake Rudolf. Neumann was a mighty hunter and well acquainted with the distinguishing characteristics of the various species of game animals in the country which he traversed. During his elephant shooting he found time to collect specimens of many of the species of big game, and to these efforts are due the discovery of the reticulated giraffe, Neumann hartebeest and the notata Grant gazelle.

Oscar Neumann entered British East Africa from the German protectorate by way of the Rift Valley. From the Rift Valley he journeyed across the Loita Plains to the shores of the Victoria Nyanza, which he followed northward to Mount Elgon and then west into Uganda. The route followed by him upon his departure from the country was very much the same as that taken by Joseph Thomson some years previously and now commonly known as the old caravan route to Uganda. From his collections have been described the Uganda bushbuck, *Tragelaphus dama*, the steinbok, *Raphiceros neumanni*, and the Masai lion, *Felis leo massaicus*. Many small mammals and birds were also discovered and described by Neumann.

During this same year, Doctor J. W. Gregory made a geological and exploring tour of Mount Kenia and the Rift Valley. While engaged in this work he made collections of the smaller mammals, birds, reptiles, invertebrate animals, and plants. A few years later, in 1897, Lord Delamere entered the country from the north by way of the Gallaland desert. Much of his time during this journey was given to elephant hunting about Mount Marsabit and the region north of the Guaso Nyiro River. Among the specimens collected during this trip and presented to the British

Museum by Lord Delamere were two new species, the Somali wart-hog, *Phacochœrus delamerei*, and the desert bushbuck, *Tragelaphus delamerei*. A notable discovery, in 1900, was made by Major Gibbons, who discovered the white rhinoceros in the Lado Enclave while engaged on his exploration of Africa from south to north.

Two years later Major Powell-Cotton entered upon his exploration of the region northwest of Mount Elgon to the banks of the Nile. He traversed the highlands bordering the Turkana country and the region about Mount Agora, much of which had never before been visited by a European. A detailed account of this region and the hunting experiences which befell this sportsman are given in his book, "In Unknown Africa." The chief object of this exploration was the gathering of specimens of the game animals inhabiting the district. Two subspecies of giraffe have been named from this material, *Giraffa camelopardalis rothschildi* and *G. c. cottoni* and the highland oribi, *Ourebia montana cottoni*, besides several other less distinct races.

The most recent big-game animal to be discovered in East Africa is an obscure forest species, the giant forest pig. Lieutenant Minertzhagen was instrumental in bringing this remarkably distinct pig to the notice of naturalists. In 1905, while engaged in exploring the forest regions of Mount Kenia, he secured from some of the Wandorobo pieces of the skin of a large pig. Later he secured other similar pieces of skin, together with two skulls of a similar pig in the Kakumega forest lying at the base of the Nandi Escarpment. These skulls enabled Oldfield Thomas, of the British Museum, to determine the relationship of the animal, which proved to be a new genus and quite intermediate between

the very aberrant wart-hog and the common domestic pig or wild boar. The pig has been named *Hylochærus minertzhageni*, and since its discovery, in 1904, several complete specimens have been secured from the Wandorobo. Minertzhagen further secured, near Kenia, a new species of oribi, *Ourebia kenyæ*, the range of which is confined to a small tract of country skirting the southeast base of the mountain.

The British Museum sent in 1905 a natural-history expedition to the Ruwenzori Range. The territory covered by the expedition was confined to the slopes of the mountain, where no large game was encountered, but where many new species of small mammals, birds, insects, and plants were secured.

The Smithsonian African Expedition, under the direction of Colonel Theodore Roosevelt, made collections of large-game animals in British East Africa, Uganda, and the upper Nile districts during 1909 and 1910. The chief object of the expedition was the collecting of specimens of all of the game animals occurring in the territory traversed. Among the specimens secured by the expedition were a new subspecies of sable antelope, *Egocerus niger roosevelti*, and three new races of hartebeest; a Nile race of *lelwel*, *roosevelti*, a Rift Valley race of *cokei*, *nakuræ*, and also a highland form, *kongoni*. In addition, several new species of smaller antelopes were distinguished in the collection as well as a large number of small mammals and birds.

During the past eight years large numbers of sportsmen have shot over the game fields of British East Africa. The highland region is, without doubt, the best-known big-

game field in the world. The game animals of this portion of Africa are now almost as familiar to us as our own deer, bison, or bear. Notwithstanding this familiarity with the healthful highlands, there yet remain large tracts of country in the desert lowlands which are either wholly unknown or known only to a handful of hardy adventurers.

CHAPTER II

DERIVATION OF THE FAUNA, GEOGRAPHICALLY AND PALEONTOLOGICALLY

A—Geologic Formation

The greater part of the area comprised in British East Africa and Uganda is of Archæan age, being gneissic in structure and derivation. All of the desert lowlands and the higher grass-lands which flank them are comprised in the gneissic area, together with the hills and mountains which rise above them, including the lofty fault range of Ruwenzori. Capping the central portion of the Archæan region we find a more recent volcanic or eruptive rock series composed of various lavas. The whole highland region of both East Africa and Uganda, including the lofty volcanoes of Kenia, Elgon, and Kilimanjaro, are of this formation. The Rift Valley has been the most recent source of the lava cap which covers the highlands. The lavas of this age have been erupted from fissures in the vicinity of the Rift Valley, which comparatively recently formed a great arch of eruptive rock, from the apex of which the lava flowed east and west over the gneissic region. Later the central portion of the arch dropped a few thousand feet, forming the great rift, now known as the Rift Valley. Muff in his account of the geology of British East Africa * has described this formation as the

* Colonial Reports, Misc., No. 45, Jan., 1908, p. 27.

"falling of the keystone" of the great lava arch. Previous to this other masses of lava poured from the volcanic centres of Kenia, Elgon, and Kilimanjaro, and these were later augmented greatly by the Rift Valley flow. Elgon and Kilimanjaro, both of which are crowned by well-preserved craters, are the most recent volcanic sources of this lava flow, while Kenia, being much older, has been denuded of its crater by weathering and is now capped by a precipitous peak representing the old volcanic neck. The Rift Valley exhibits a score of smaller and still more recent volcanoes; indeed, it is of such recent formation that its many independent drainage systems have not been established long enough to allow erosion to unite them into a common system. The "falling of the keystone" which established the Rift Valley has been of quite recent date. The Ruwenzori Range, although in close proximity to districts covered by recent lava flows, is a series of gneissic or crystalline peaks formed by faulting and is without any evidence of volcanic structure.

The only rocks not of eruptive or igneous origin are a narrow belt of corals and sandstones bordering the coast and extending inland from the seashore to a distance of approximately fifty miles. The newest or most recent of such formations is the coral limestone forming the coast plain, which is of Pleistocene age. Dipping under the coral formation we find a series of shales of Jurassic age, which is exposed for several miles in width near the station of Changamwe. Beyond Changamwe successive exposures of yellowish sandstone are encountered between Mazeras, Mariakani, and Maji ya Chumvi stations, and beyond these a series of grits as far inland as the Taru Hills. The sand-

stones and grits are the oldest sedimentary deposits and have been assigned to Triassic age. The dip of all of these beds is toward the coast as is that of the Archæan gneiss which underlies the Taru grits and comes to the surface near Mackinnon Road station. The narrow coast belt of sedimentary rocks is a very incomplete geological series without any formations of Tertiary age or any older than a doubtful Triassic sandstone. No vertebrate remains have been found in any of these formations.

From the gneissic rocks have been derived the bright-red gritty soil of universal occurrence in the desert nyika. In the grassy uplands a black cotton soil is met with on grassy steppes, notably the Kapiti and Athi Plains. Its dark color is apparently due to vegetable humus and alkaline salts from the red soil. The volcanic lavas are made up chiefly of trachytes on the higher altitudes, with phonolites underlying them, which are found exposed at the lower levels near the Archæan rocks. The lavas give rise to a bright-*red clay*ey soil containing a large per cent of ferric oxide and resembling in color the red gneissic soil of the desert lowlands. So wide-spread are these various soil conditions over areas extending through several faunal zones that no botanical or zoological significance in distribution has been found attributal to their influence.

B—Derivation

In all the literature pertaining to zoology there is nothing, perhaps, more unstable than the theories of derivation based upon paleontological evidence. The discoveries of new forms of animals or groups in new horizons and localities which are constantly taking place give a kaleidoscopic

effect to this field of theory. Notwithstanding the present apparent futility of such speculation, participation in it is irresistible. We may justify such indulgence of the fancy as a groping toward the light or a legitimate attempt to illuminate the obscurity surrounding the remote past. In the northern hemisphere or holarctic region the paleomammal records are at least partially complete in some few groups, but in Africa the paleontological records are so absurdly scanty that we are left with hardly a straw to support our speculation. Africa is so dark paleontologically that we may almost consider ourselves engaged in mere guesswork.

Localities in which mammal remains have been found in Ethiopia, or Africa south of the Sahara Desert, are limited to a few small deposits. In the Cape region are two deposits of Pleistocene age containing species allied to or identical with those existing to-day in the same district. The most important of these localities is Barkley West, situated on the Vaal River, near the boundary of the Orange River Colony. Fraas described, in 1907, from this locality, a species of *Damaliscus*, a hippopotamus, and a mastodon. From the Zululand coast, in Natal, Scott* has described a buffalo, a black rhinoceros, a hippopotamus, and an elephant; all forms closely related to living African species. Broom has recently described from the Orange River a Pleistocene species of hartebeest allied to Coke's, but exceeding it in size, and a large horse from the shore deposits near Cape Town. More recently part of a mandible of a *Dinotherium*, a primitive elephant bearing mandibular tusks, together with remains of various other animals, have

* "Geol. Surv. Natal and Zululand," 1907, p. 253.

been discovered on the eastern shore of the Victoria Nyanza, near Karungu, British East Africa, in beds of Miocene age. Other fragments supposed to belong to a *Dinotherium* have been found in the lower Omo River near its entry into Lake Rudolf.

North of the true African region we find extensive deposits of mammal remains near the Mediterranean. The oldest of these are the Fayum beds of Eocene, Oligocene, and Middle Miocene ages, situated near Cairo. In the Eocene beds have been found remains of the toothed whales, sirenians, and generalized mammals allied to tapirs and elephants. Overlying these in the Oligocene beds remains of giant hyraxes and primitive proboscidians have been obtained. A large mammal, *Paleomastodon*, allied to the elephant, has been found in the Miocene beds, together with a primitive rhinoceros.

Mammals closely related to the existing African species are first met with in the Pliocene of Algeria. The waterbuck, the gazelle, and an antelope allied to the eland occur in beds of this age, together with remains of a horse, *Hipparion*, a hippopotamus, and the sabre-toothed tiger. During the Pleistocene age which followed there existed in North Africa many species of antelopes. Beds of this age in Algeria contain the remains of several species of hartebeests, two duikers, a reedbuck, several gazelles, two sable or roan antelopes, a koodoo, one eland, and two species of buffalo. This is almost as great a number of species as we find living to-day anywhere in Africa south of the Sahara Desert.

Our data for the determination of the geological history of African mammals are thus very scanty. Almost the only Ethiopian records are Pleistocene, which is too recent to con-

tain marked ancestral forms. North Africa, on the other hand, has been since Pliocene time in close connection with Europe and Asia and dominated by the same fauna. The Pliocene fauna of North Africa was practically the same as that occurring contemporaneously in southern Europe and Asia. The same fauna exists in the game fields of East and South Africa to-day. Before the Pleistocene dawned in Europe the great bulk of the antelopes and carnivores of African affinities had disappeared and were replaced by a fauna similar to that which exists there to-day. The deer, sheep, ibex, bear, and boars which characterized this fauna entered North Africa by way of the land connections at Suez and Gibraltar, but were not able to cross the Sahara Desert into tropical Africa. Africa in Miocene* time was cut off as a continent from Europe, but unfortunately we have only a few beds in the Fayum referable to this age. They contain only primitive proboscidians and rhinoceroses. In addition to this evidence we have the Miocene *Dinotherium* from the Victoria Nyanza. What evidence we have would lead us to assume that the antelopes had not yet reached Africa in Miocene time. Eurasia, however, in the Miocene reached its climax of antelope forms, supporting eleven genera, four of which still survive in Africa. During the Oligocene and Miocene of Eurasia there appeared many new genera either identical with or closely allied to those found to-day in Africa. Such genera are represented by the aardvark, the scaly ant-eater, the black rhinoceros, the chevrotain, the springbuck, the gazelle, the sable or roan antelope, the oryx, the koodoo, the bushbuck, the eland, the

* Mathew, "Outlines of the Continents in Tertiary Time," Bull. Am. Mus. N. H., XXII, p. 353, connects Africa during the Miocene with Eurasia; but the distribution of antelopes during that time does not support such a connection.

giraffe, the hyena, the civet, and the mongoose. Nearly all of these forms continued to exist in southern Europe and Asia until the close of the Pliocene. The commonly accepted theory, however, derives the present African fauna from southern Europe and Asia. The facts which we have at present certainly support this theory, but the case is not well balanced, Eurasia with its extensive Miocene beds being weighed against the Miocene void in Africa. What mammals inhabited Ethiopian Africa during middle or early Tertiary times we do not know, as no fossil-bearing beds of these ages have been discovered. It is certain, however, that Africa is one of the oldest continents and may well have been the birthplace of some groups of mammals. Osborn,* from the evidence found in the Fayum beds, considers it probable that Africa was the original home of the elephants, sirenians, toothed whales, and hyraxes. Notwithstanding the presence in the Mediterranean region of Africa of early Tertiary generalized types of *Proboscidea*, *Hyracoidea*, and ungulates, it is doubtful whether such forms gave rise in any important degree to the present African fauna. These Miocene forms exhibit such primitive characters that their relationships with the modern fauna cannot be well established. Owing to the incompleteness of the fossil records, the direct ancestral forms of the living antelopes are still unknown. The Miocene antelopes of Europe and Asia were as specialized as the existing species, while, in the older beds of Oligocene and Eocene age, allied types are quite wanting.

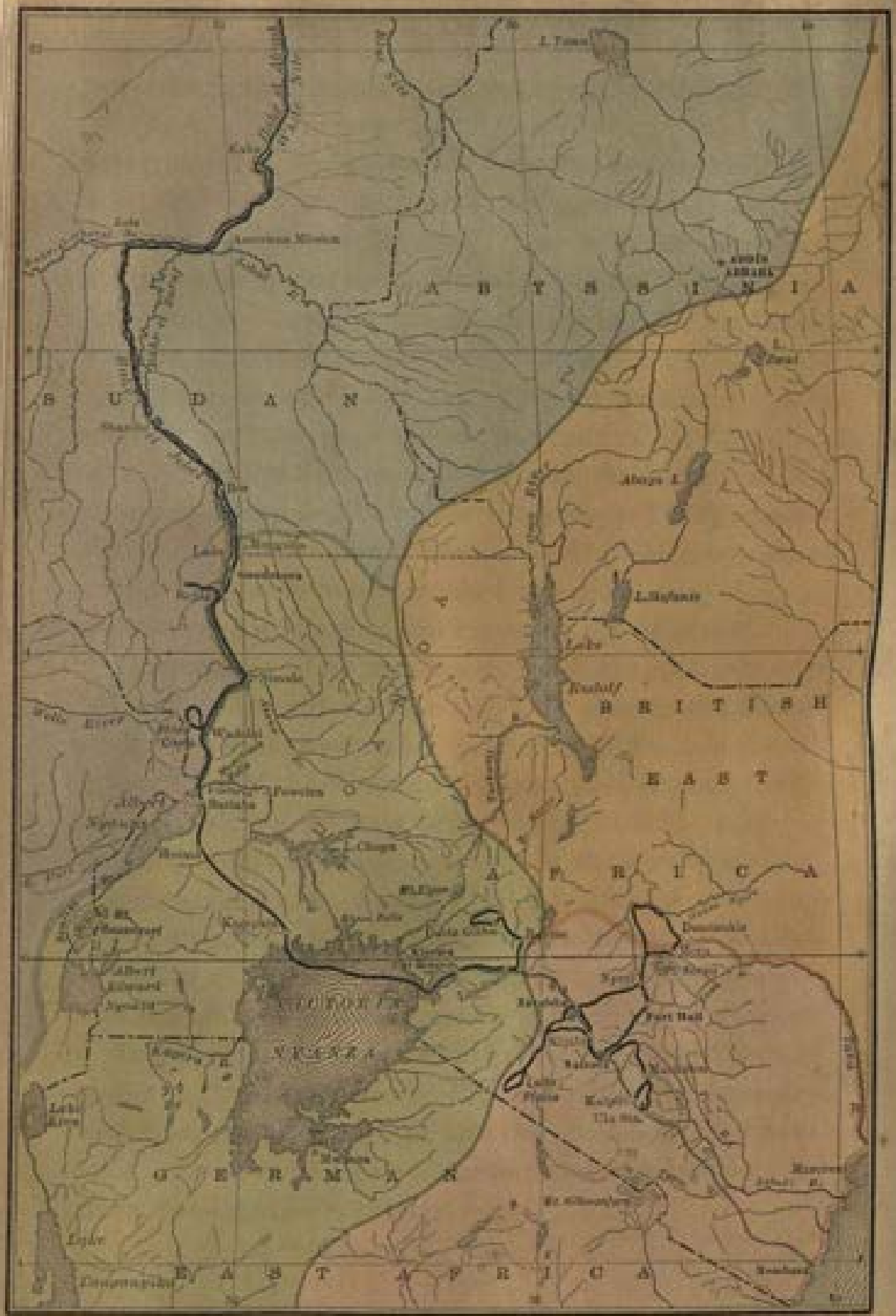
The large island of Madagascar, which to-day has a very peculiar fauna of lemurs, insectivores, and rodents, does not

* Osborn, "Age of Mammals," 1910, p. 73.

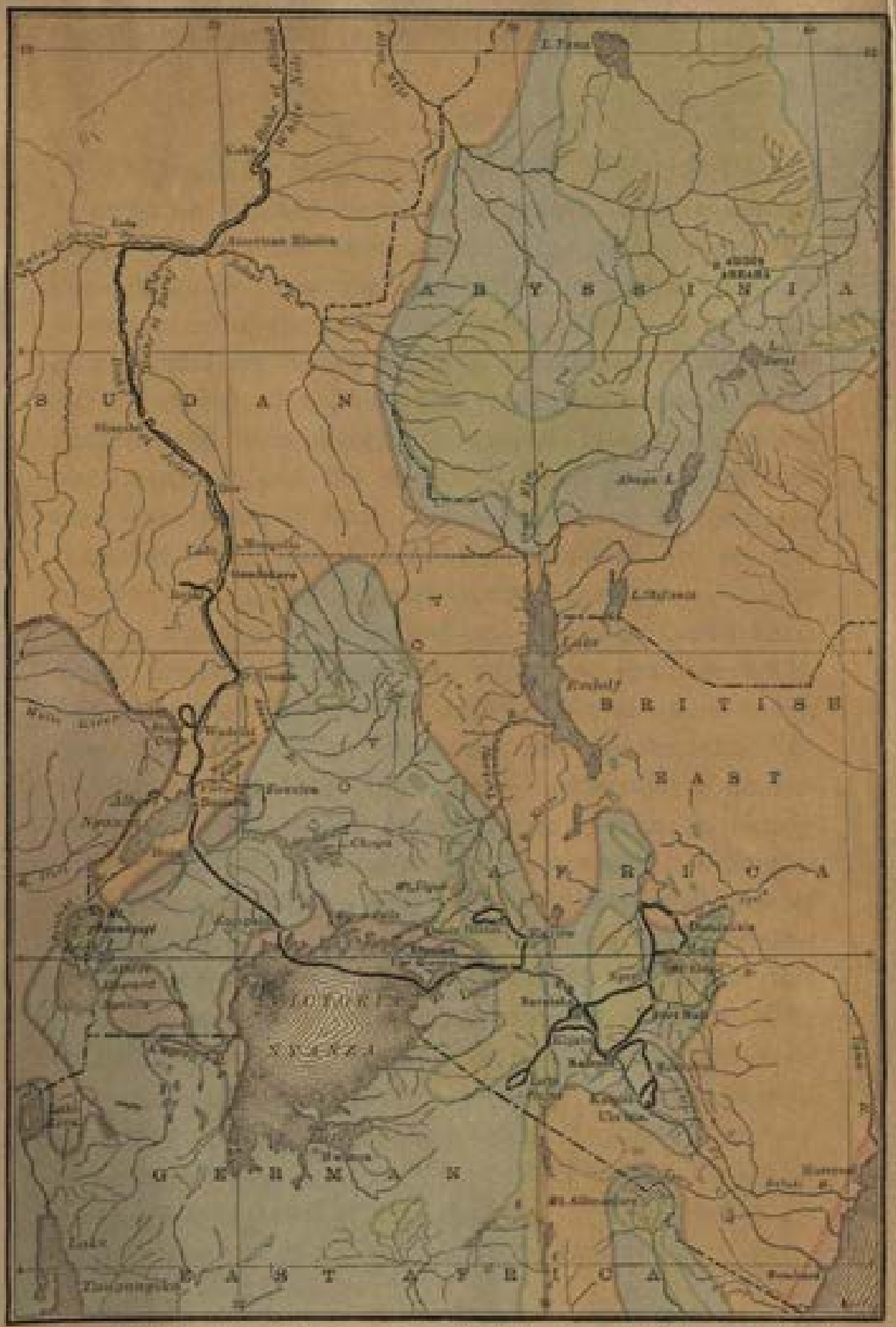
throw much light on the derivation of the continental African fauna. The present fauna of the island gives conclusive evidence of its separation from the African continent before the influx of the present big-game fauna, probably some time before the Miocene. Just what its connection was previous to this age is doubtful, but its fauna may, as suggested by Sclater,* represent the ancient African fauna. Since its separation several strays have reached it; in the Pleistocene two species of pigmy hippopotamus and more recently the bush pig. A fair per cent of its *Chiroptera* have, without doubt, recently reached the island, so that to-day its fauna is of a mixed character. This is equally true of its earlier fauna. The lemuroids, which now characterize it so remarkably, reached the island long after the insectivores had attained their present specialization.

Immediately after the close of the Cretaceous period in Africa there existed a connection with Eurasia and Madagascar which allowed an intermigration of the land fauna. During most of the Eocene, Oligocene, and Miocene, Africa was isolated from Eurasia but connected with Madagascar. This long interval gave ample time for the development of specialization in the mammals of Ethiopia. But we are practically without any records of the mammals inhabiting Africa at this period. The fragmentary evidence of the Fayum beds is quite insufficient for the building of a picture of the life of the vast continent of Africa which was then in outline quite as at present. Much of Africa has been dry land since the Permian age, and the great bulk of the interior is to-day covered by Archæan rocks, which would indicate a much greater antiquity.

* Sclater, "Geog. Mams.," p. 108.



MAP I—FAUNAL AREAS OF EAST EQUATORIAL AFRICA



MAP 2—LIFE ZONES OF EAST EQUATORIAL AFRICA

The heavy black line on this map indicates the route of Col. Roosevelt's African expedition of 1909-10.

C—Present Distribution

The big-game fauna of British East Africa and Uganda is made up of three elements, or rather has been derived from three different faunal areas. The chief source of this derivation has been the South African region, to which three-fourths of the species are closely allied. A considerable number are closely allied to Somaliland or northeast African species, while a very few, chiefly forest animals, have been derived from the Congo region. The large carnivorous mammals and the elephants are so generally distributed that there is little faunal significance to their distribution. The faunal divisions recognized are on this account based upon the hoofed mammals solely.

The region may be divided into two large faunal areas which coincide with the two important drainage areas. The greater of these in area and number of species is the coast and Rift Valley drainage; the smaller, the Nile watershed. The Rift Valley, though consisting of numerous small independent lake-drainage systems is closely allied faunally to the coast area, from which it differs by almost no peculiarity. The real faunal barrier is west of the Rift Valley, at the meeting of the Nile watershed and these independent systems. Throughout the region this barrier is marked by high mountains and plateaux. The coast and Rift Valley drainage area is characterized in its upper or highland portion by rolling, grassy plains flanked on their higher parts by the forests which clothe the mountain ranges of the district. On the lower borders the grassy plains merge gradually into the dry scrub of the thorn-bush deserts of the lowlands. In the immediate vicinity

of the coast the desert scrub gives way to a humid tropical vegetation of palms and forest trees. The great herds of game are the characteristic feature of the grassy upland steppes. They occur less numerously in the desert scrub and are quite rare in the forest. Many more species are peculiar to the coast-drainage area than to the Nile watershed. To this region are confined the two gazelles, gerenuk, impalla, sable, oryx, lesser koodoo, rock reedbuck, dikdik, wildebeest, the reticulated and Masailand giraffes, the common waterbuck, Coke hartebeest, Hunter antelope, steinbok, and Haggard oribi. Within this area the most important physical barrier is the Tana River. This stream is broad and deep enough to act as a barrier across the desert portion of the coast slope from Mount Kenia eastward to the sea. The aversion which most antelopes have for crossing rivers is due no doubt chiefly to the fear of attack by the crocodiles which haunt the streams. The ungulates which range as far south as the Tana River but do not cross to the south bank are Grévy zebra, reticulated giraffe, Hunter antelope, beisa oryx, Rainey gazelle, Günther dikdik, and Somali wart-hog. We find a less number of species reaching their northern limit on the south bank. The best marked of these are Peters gazelle, Masailand giraffe, Coke hartebeest, fringe-eared oryx, steinbok, and Masailand wart-hog.

The southern limits of the Tana or British East African fauna are marked on the east by Kilimanjaro and the ranges of Usambara and Pare which link it with the coast. Westward the fauna is continued on down into German East Africa by way of the Rift Valley as far as Ugogo, where the lesser koodoo and fringe-eared oryx reach their southern

limit. The southern limits of the range of a northern carnivore, the striped hyena, coincides with that of the two antelope, but the gerenuk is stopped by the highlands of Kilimanjaro. Extending northward and meeting this fauna in German East Africa we find two characteristic Zambesi antelope, Lichtenstein hartebeest in the Rift Valley and the sable on the coast slope, the latter penetrating as far north as Mombasa.

The Nile watershed comprises all the country west of the Mau escarpment or its continuation northward into Abyssinia. The Mau proper is a high plateau extending from the German border northward to the vicinity of Mount Elgon, retaining an elevation of from eight thousand to ten thousand feet unbroken. North of Elgon in the latitude of Lake Rudolf it falls away and loses its character both as an escarpment and a faunal barrier. It rises again in the Aybssinian highlands and effectually prevents the desert lowlands of the Red Sea coast from coming in contact with the Nile lowlands. The Nile faunal area is better characterized by what it lacks than by any peculiar animals it possesses. The kobs, genus *Adenota*, and the *Bubalis lelwel* type of hartebeest are common to the whole area, besides which there are a considerable number of distinct species peculiar to certain parts of the drainage system. In contrast to the coast slope it lacks the dikdiks, wildebeests, oryx, steinbok, rock reedbuck, gerenuk, and impalla. Gazelles occur only in its lower desert levels on the northern frontier.

Two fairly well-marked regions may be defined within this area due to differences in altitude and moisture. The higher or Uganda region comprises the Victoria Nyanza

lake region and the territory extending northward and east of the Nile. To this area are confined the common eland, the quagga zebra, the Cape buffalo, and the klipspringer. Uganda proper is to a large extent dominated by an extensive growth of tall cane grass which forms suitable cover only for buffalo and elephant. Northward, however, and on the eastern or Mau drainage of the lake the open plains and bush country support much game.

North of the Uganda region we meet with a drier and lower region, the Bahr-el-Jebel Nile. In character this region resembles the Soudan of which it is a part. It consists of level grassy steppes interspersed with thorn trees and bush and subject to a distinct wet and dry season. The Nile in this region proves a very important faunal barrier to much of the big game. To the region west of the Nile which may be known as the Bahr el Ghazal district we find limited the white rhinoceros, the giant eland, the Congo giraffe, and the typical lelwel hartebeest. The region east of the Nile or the Uganda Soudan has an even larger number of species confined to it or rather prevented by the Nile from entering the Bahr el Ghazal. Such species have reached it recently from the southeast. The most important of these recent arrivals are the black rhinoceros, quagga zebra, common eland, Uganda giraffe, Roosevelt hartebeest, and red-fronted gazelle. The Abyssinian buffalo, Nile oribi, roan antelope, Thomas kob, and Nile bushbuck are common to both sides of the Nile.

Besides the regional distribution of animals into areas limited by various physical barriers, we encounter within the zoogeographical areas a zonal distribution which is based on climatic and floral factors and is quite independ-

ent of other barriers. The zones occur in East Africa as broad bands of territory extending parallel to the coast, owing to the uniformity with which the land rises as we proceed inland to the high central plateaux. Within each zone the altitudinal and climatic conditions and plant species are fairly uniform. The zones, owing to the irregular distribution of the flora, can be further subdivided into plant associations such as grassy plains, thornbush thickets, or dense forests. By using the zonal names in connection with the plant associations, we are enabled to define very precisely the habitats of the various animals inhabiting the region. The zones are primarily upon a floral basis, being founded upon the ranges of various trees and shrubs to which the distribution of a majority of the animals conform. The zones with the plant species peculiar to them are described at length in the chapter concerning the flora.

The whole region under consideration falls naturally into five life-zones. Beginning at the coast, we find a narrow belt of lowland varying in width from five to twenty miles and extending from the Lamu Islands southward. This tropical belt is marked florally by the occurrence of the cocoa-palm, and climatically by the greater amount of moisture it receives in comparison to the desert which succeeds it. Peculiar to the tropical coast zone are the sable, *Egocerus niger roosevelti*, the suni, *Nesotragus moschatus deserticola*, the blue duiker, *Cephalophus monticola hecki*, and the maritime oribi, *Ourebia montana haggardi*. The sable extends no farther north than Mombasa, but the other species of antelope extend to the northern limits of the zone near Lamu. The sable and the oribi are more characteristic of the parklike country bordering the groves of cocoa-palms than of the

zone proper, but they do not extend beyond this intermediate strip into the dry desert. Other game animals occurring in the zone, but not characteristic of it, are the yellow reedbuck, Cape buffalo, the bushbuck, the elephant, the lion, and the leopard.

Immediately succeeding the coast belt the desert nyika stretches inland, covering almost one-half of the entire region. In British East Africa it is broken by the elevated highlands, but northward, in the latitude of Lake Rudolf, it extends unbroken to the Nile. The nyika is low, the great bulk of it less than two thousand feet elevation, with a hot, dry climate and subject to a long dry season and one or two short rainy periods annually. The whole region is covered by scattered thorn-bush or by impenetrable jungles of thorn trees, euphorbias, aloes, and sansevierias. Grassy plains are rare, as well as absolute deserts devoid of vegetation. The nyika zone resembles the Somaliland country closely, and many of the animals which are characteristic of it have been derived from this source. Its two most peculiar and wide-spread types are the gerenuk and the oryx. Others are Grévy zebra, Hunter antelope, both the greater and the lesser koodoo, the reticulated giraffe, Peters gazelle and Günther dikdik. A host of other game animals occur in the nyika, but are not confined to it. Such are Coke and Neumann hartebeest, the topi, the impalla, the common waterbuck, the bushbuck, Kirk dikdik, the common eland, the Cape buffalo, the Kilimanjaro giraffe, quagga zebra, the wart-hog, the bush pig, the elephant, the lion, the leopard, the cheetah, and the hunting dog.

The region most frequented by sportsmen is the high-

land veldt zone, which is characterized by its rolling prairies of grass and its verdant appearance. Green rolling prairies are, however, only one of its features. Much of it is covered by scattered growths of acacia trees or weird candelabra euphorbias. The altidudinal range extends from three thousand to eight thousand feet, with correspondingly great differences in temperature. The region, however, is uniformly well watered, but the rainy seasons are irregular except in the western or Uganda section. There is scarcely an antelope which is peculiar to the whole zone, although many are peculiar to certain parts of it. Antelope which are found only in the veldt zone are the wildebeest, Thomson gazelle, Jackson, Uganda, Kongoni, and Nakuru hartebeests, klipspringer, steinbok, and the five-horned giraffe. Many others share this zone with the nyika. Such are the black rhinoceros, quagga zebra, common eland, topi, bushbuck, waterbuck, kob, roan, dikdik, oribi, reedbuck, suni, and various species of duiker, wart-hog, and bush pig.

Extending above the veldt zone we find the highland forest, ranging from six thousand to ten thousand feet in altitude. It is a uniformly dense assemblage of trees of mixed tropical and mountain affinities and strikingly different in appearance from our northern forests. The well-known families to which our oaks and beeches belong are not represented, their places being taken by trees belonging to families of the higher flowering plants peculiar to the tropics. The pines and firs are likewise lacking, the only representatives of the conifers being a single species of juniper and two species of African yew. The rose family, to which most of our fruit-trees belong, is likewise conspicu-

ous by its absence, being represented by only a few species of brambles and alpine shrubs. The forest is a mixture of many species of trees, vines, and undershrubs. The chief forest-trees are species of figs, olives, camphor, cloves, sapote, and various genera related to the euphorbias, acacias, and coffee. Various species of large vines link the forest together, while prickly undershrubs allied to *Acanthus* add to the impenetrable nature of the tree growth. In the higher altitudes the yew and juniper predominate and give the elevated region a more northern aspect. Bordering the forest at its upper altitudes is a dense zone of bamboos, which at a distance has the appearance of fields of tall grass. The bamboo *Arundinaria alpina* occurs from nine thousand to ten thousand feet as a pure growth to the exclusion of all other vegetation, not excepting undershrubs. It forms a waste quite uninhabited by animal life, although elephant, and very rarely roan antelope, at times penetrate it.

The bamboo is lacking on Kilimanjaro and the high mountains in its vicinity. In the Nile district of Uganda and the Lado Enclave a lowland bamboo occurs, *Oxytenanthera abyssinica*, which is a member of another genus and quite distinct from the peculiar high-mountain species found on Kenia, the Aberdares, the Mau and Kikuyu escarpments, Mount Elgon, and the Ruwenzori Range.

Peculiar to the forest we have the bongo, the giant forest pig, and Abbott duiker. The dense nature of the forest has made it possible for these animals to escape discovery until within the last few years. They are still nearly unknown to white hunters, being familiar only from the specimens shot or pitted by the Wandorobo bushmen.

But one or two instances of either the bongo or forest pig having fallen to the rifle of the white man have thus far been recorded. The Abbott duiker is still only known by the original specimen secured by Doctor Abbott a score of years ago in the forests of Kilimanjaro. These three exclusively forest animals are of West African affinities and have reached East Africa by way of the straggling forests through Uganda and the upper Congo. Other game animals which are confined to the forest are the red duiker, the bush pig, the suni, the bushbuck, the elephant, and the leopard, the last being the only large carnivore which enters the forest. Many of these game animals are found widely distributed in the lowland forests of Uganda and the tropical coast belt.

The moorland zone succeeds the forest on the high mountains of Kenia, Kilimanjaro, Ruwenzori, Elgon, and the Aberdare Range. It extends from the upper limits of the bamboo at ten thousand feet to the lower margin of the snow-fields at fourteen thousand five hundred feet. The country between these altitudes is an open moorland of boggy soil overgrown by dense masses of shrubby alchemillas and tussocks of reeds and grass. Tree-heaths occur throughout the lower levels of the zone and grotesque tree-like groundsels and lobelias in the upper altitudes. Great numbers of rodents occur in this high, cold region, but the antelopes are represented by only a single resident species, the Abyssinian duiker, *Sylvicapra grimmi altivallis*. The Cape buffalo occasionally reaches the moorland as a straggler. There is a record of one on Kenia which perished recently in the snow at fifteen thousand feet, where its remains still lie. Elephants are also oc-

casional visitors, their tracks being quite numerous in the boggy soil of the moorland. Two carnivores occur, the serval cat, which is resident in the moorland, and the leopard, which is simply a visitor in the region.

CHAPTER III

THE FLORA OF EAST AND MIDDLE AFRICA AND ITS RELATION TO THE FAUNA

Two floral types stand out conspicuously in East Africa and give the landscape its peculiar African character. These two, the acacias and the giant euphorbias, are the dominant tree forms, and are wide-spread throughout the steppe and bush country. Although both genera are cosmopolitan, there is no other country in which the euphorbias assume the giant, candelabra-like tree growths or where their association with flat-topped acacia trees occurs. These peculiar tree growths extend throughout the whole region occupied by the game fields, and dominate the real Africa of the sportsman. Both of them have, however, received erroneous names at the hands of sportsmen. The acacias are usually referred to as mimosas, a genus which occurs in the region, but only as a small prickly shrub in swampy districts. The tree euphorbias are often referred to as cactuses because of their close resemblance in form to the giant species of the American deserts, with which they have no real relationship, being closely akin to some of our common roadside weeds, the spurges. In the lower, drier parts of this region two other conspicuous tree growths appear which are much more peculiarly African, but are less wide-spread. These latter, the grotesque gouty baobab and the branching doum-palm, are not found beyond

the Ethiopian region. The country dominated by these four arboreal types extends from the coast inland to an elevation of seven thousand feet, covering practically all the region except a few forested highland areas and a narrow coast strip. The forests of the highlands and mountains are composed largely of trees which belong to peculiar African genera, but exhibiting no such peculiarity in appearance as the baobabs and the branching palms. The great bulk of the plants which occur in East Africa are members of genera found in India or are wide-spread in tropical Asia and America. The vegetation is nowhere tropical or luxuriant in growth except in the highland forests. Even at the coast the rainy season is short and the country has a semiarid appearance. The greater part of the lowland country below four thousand feet is desert in character with xerophytic plant forms chiefly.

The thorny acacias in either tree or bush form are dominant everywhere below an altitude of six thousand feet or outside of the forested areas. They are primarily plains or riverside trees and are never associated compactly into dense forests. The *Leguminosæ* are represented by many other genera in the region under consideration, and exceed the other families in number of species. Next in number of species is perhaps the *Rubiaceæ*, of which the coffee-bush is typical; it occurs as one of the native shrubs in Uganda. The great bulk of the smaller trees and shrubs of the highland forest belong to this family. The *Rosaceæ* are only represented in the high mountain forests and alpine regions, where many of the moorland shrubs and a few trees belonging to the order are found. The great bulk of the trees and shrubs belong to the tropical orders of *Sapotaceæ*,

Apocynaceæ, *Burseraceæ*, *Tiliaceæ*, and several others, all of which are unfamiliar to botanists from north-temperate zones. The conifers are found only in the highlands, where they are represented by a typical juniper, a tree of wide range, and by two species of yews of the tropical genus *Podocarpus*. Palms are quite an inconspicuous feature in East Africa; but four or five species occur and they are only abundant locally.

Large areas in the highlands of British East Africa and in Uganda and the Nile Valley are covered by a heavy growth of grass, forming treeless plains of considerable extent. One or two species of grass usually predominate in the plains, but many different species are represented in the various districts where grass veldt occurs.

The whole region falls naturally into five floral or faunal zones based primarily on climatic differences due to moisture and altitude and characterized by peculiar tree or plant species. The zones succeed one another as the country rises from the coast to the highlands in the interior and extend parallel with the coast as broad bands of territory. The higher zones, which are found only on mountain slopes or summits, occur as islands in the lower zones.

The animal life is dependent chiefly upon certain plant species, and on this account conforms quite closely in distribution to the floral zones in which such species occur. Throughout the zones the distribution of the plants comprised in each is by no means uniform, for each zone is made up of several distinct plant associations. Because of the dependence of the animals upon certain plant associations they seldom occur generally distributed in the zone. Plant associations are really the most important floral factors in

the distribution of animals and are the most precise means of defining their ranges.

Extending along the coast from Lamu southward is a narrow strip of country which is well characterized by the groves of cocoa-palms which grow luxuriantly on the low coral coast plain and the hill country inland to an altitude of five hundred feet. This stretch of low country may be known as the tropical coast zone. It receives considerably more rainfall than the dry desert country flanking it, and supports a luxuriant vegetation during the short rainy season, but is semiarid in character, with little semblance of tropical luxuriance. The cocoa-palm marks the zone precisely, extending from the seashore inland to the summits of the low coast hills.

On the Uganda Railway the zone extends from Mombasa to Mazeras, having a width here of fifteen miles. Farther north it narrows down to a few miles in width, owing to the coast hills approaching the coast and confining the coastal plain. At the Tana River it broadens again and extends up the alluvial valley a score of miles. Still farther north beyond Lamu it gives way entirely to the desert, which here reaches the seashore. Several plant associations are found within the zone. A mangrove association composed largely of three species of mangroves, *Rhizophora mucronata*, *Bruguiera gymnorrhiza*, and *Avicennia officinalis*, occupies much of the territory about the inlets and the tidal portions of streams. Forests occur in places on the slopes and crests of the coast hills. They are quite dense assemblages of a variety of trees, chief among which is the giant *Trachylobium hornemannianum*, a wide-spreading, white-barked tree. Other common forest-trees are

Afzelia cuanzensis, and species of *Combretum* and *Albizzia*, which are mixed with an undergrowth of scrubs allied to *Acanthus*. Much of the tropical coast zone is covered by scattered bush and grassy areas, interspersed with solitary trees of *Acacia stenocarpa*, *Bauhinia reticulata*, *Erythrina tomentosa*, baobabs, and occasional doum-palms and candelabra euphorbias.

Succeeding the tropical coast belt we find the desert nyika zone stretching far inland as a dry, thorn-bush-covered steppe. The nyika covers the greater part of the region of east equatorial Africa and in it are found most of the floral and faunal peculiarities of East Africa. All of the country lying between the altitudes of five hundred and three thousand feet are comprised in it. The Uganda Railway traverses the zone from the station of Mazeras to Makindu, a distance of one hundred and sixty miles actually, but by the railroad some two hundred miles. Northward the nyika broadens out tremendously, attaining in the region north of Mount Kenia a width of over four hundred miles, and extending unbroken from the seashore inland past Lake Rudolf to the Nile. The region is quite level, with a gentle slope to the coast, and occasional isolated hills or small mountains of gneiss rising a few thousand feet above the plain. A heavy, bright-red clay soil covers the region universally, except where the gneiss rocks project above it.

The nyika is subject to a long, dry season during which most of the trees and bushes are leafless and the soil is bare. The vegetation is on this account fitted in every possible way to resist evaporation and is typically xerophytic. During the short rainy season, which is irregularly dis-

tributed from April to June, the country blossoms out luxuriantly, all of the naked bushes and trees leafing out and the ground becoming covered with a wealth of flowering herbs and grasses. The transformation is so complete that any one passing through the region at this time cannot conceive of the desolation which is characteristic of the dry season. The two most characteristic trees are the massive baobab, *Adansonia digitata*, and the branching doum-palm, *Hyphæne coriaceæ*. Associated with these and scarcely less characteristic are the two giant euphorbias, *Euphorbia candelabrum* and *Euphorbia nyikæ*, and several species of flat-topped acacias. One of the characteristic shrubs of the region, and one which impresses itself indelibly upon the memory of the traveller, is the wait-a-bit bush, *Acacia mellifera*, which is armed with short recurved thorns. The tree acacias are chiefly *Acacia tortilis*, which form groves of large trees along dry watercourses, and *Acacia verugosa*, the green-barked acacia, which is found near running water or where the conditions are moist. A striking but irregularly distributed plant in this zone is a cycad, *Encephalartos hildebrandti*. The great bulk of the bush vegetation is made up of various species of *Grewia*, *Commiphora*, *Euphorbia*, *Aloë*, *Sansevieria*, and *Acacia*.

The plant associations we meet with in this zone are dense thorny bush, grassy plains with scattered tree growths, and riparian flora. The nyika is characterized primarily by the uniform distribution of its thorn-bush. Much of the bush grows in dense thickets, which can only be penetrated by cutting a way through with a knife or axe. Such thickets are made up largely of small acacia trees, the dagger-like leaves of several species of *Sansevieria*

and *Aloë*, arborescent and twining euphorbias, and thorny *Commiphora* bushes. Immediately bordering the coast tropical belt a grass-covered park-like prairie is found, where the bushes grow far apart and where there is an increase of moisture sufficient to allow a fair growth of grass during much of the year. The sable, Haggard oribi, and the Swahili reedbuck are limited in their distribution to this transitional area. Grassy or park-like plains of small extent occur at intervals throughout all of the nyika, but they form a very small proportion of the area. North of Mount Kenia in the desert country which extends northward to Abyssinia and Somaliland, we find the riparian vegetation quite different from that of the coast nyika, where the dry watercourses are bordered chiefly by green-barked and flat-topped acacias, with only rarely a doum-palm. In this more northern desert we find a heavy growth of doum-palms bordering the dry stream beds and marking their courses amid the low acacia and bush scrub of the desert. Associated with the palms are thickets of the gray *Salvadora persica* bushes and groves along the smaller stream beds of *Acacia tortilis* trees. The wait-a-bit, *Acacia mellifera*, with its spreading branches and hooked thorns reaching out in every direction to grasp the passer-by, covers most of the desert together with *Grewia populifolia* and thorny *Commiphora* bushes. The baobab is absent from this district.

On the sides of the hills and mountains this steppe vegetation is augmented by groves of tall, palm-like *Euphorbia nyikæ* or the columnar *Euphorbia candelabrum*, the flat-topped *Acacia stenocarpa*, the papery-barked *Boswellia* trees, and a few aloe bushes.

We have now reached the high veldt or prairie zone, where the great herds of antelope and other hoofed game are found most abundantly. Open grassy plains are characteristic of this elevated region, but nowhere are the grass areas of great extent. The highland veldt is generally of park-like appearance, interspersed by small grass plains which seldom exceed a score of miles in breadth. It is a distinctly rolling country and in places rough and much broken by cliffs and rocky ravines. The predominating soil is the red clay of the nyika, with the exception of the plains area, which is covered by a black cotton soil supporting a heavy growth of grass. The older hills and mountains are of gneiss, but much of the country is more recent and covered by lava rocks. These predominate in the Rift Valley, especially where much of the country is traversed by trachytic cliffs and broken by recent lava flows.

The high veldt zone covers the greater part of the country between the altitudes of three thousand two hundred and nine thousand feet. In its upper levels it extends into and well above much of the forest as peninsular or insular areas. Extensive areas of grassy veldt occur on the summit of the Mau plateau at eight thousand and nine thousand feet confined by the wall-like edges of the dense highland forests. On the northern slopes of Mount Kenia the veldt region breaks the forests' girdle of the mountain and extends as a wide peninsula upward to the alpine moorland where it attains an altitude of ten thousand feet. The highland veldt zone is much less in area than the nyika. It covers the head-waters of the coast streams, the greater part of the Nyanza drainage, and the Uganda region west-

ward almost to the shores of the Albert Nyanza and the Bahr-el-Jebel Nile.

Much of the tree vegetation which is characteristic of this zone occurs also on the border of the forested regions rising above it. The quaint straggling *Croton elliottianus*, the African yew, *Podocarpus gracilior*, the olive, and *Albizzia fastigata* are trees of this sort. A very characteristic tree or small shrub is the gray sagebush-like camphor-bush, *Tarconanthus camphoratus*, which covers large areas in the Rift Valley, Loita Plains, and North Kenia districts. Associated with this are *Carissa* bushes, trees of *Acocanthera abyssinica* from the wood of which the deadly arrow poison is derived, a small, slender tree, *Dodonea viscosa*, and several species of the oak-like *Combretum* trees. From the nyika we have as stragglers both of the giant euphorbias and several tree acacias which are wide-spread in the zone and give it a characteristic African appearance. *Kigelia ethiopica* with its pendulent sausage-like fruits is a common tree in the Nile watershed.

The grassy plains which are the characteristic plant feature of the zone are covered by a heavy black cotton soil in marked contrast to the red soil of the hill and forested areas bordering them. During the rainy season a luxuriant growth of grasses a few feet in height covers the plains, but gradually it is grazed down by the great herds of game until only mere stubble is left in the dry season. The most extensive grass plains included in this area are the Athi, Kapiti, Loita, Laikipia, Naivasha, Uasin Gishu, and the whole eastern Nyanza lake steppe.

A characteristic bush of this region is the gall-covered *Acacia fistula* which forms a scattered growth over much

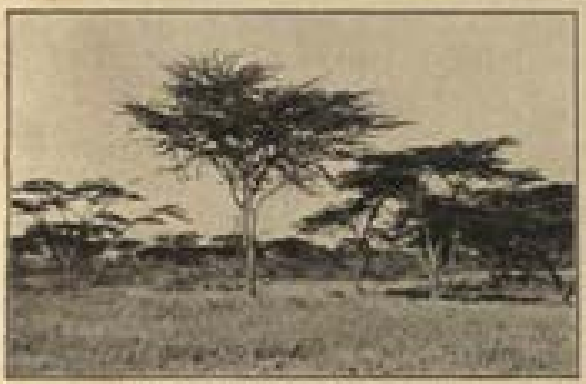
of the plains region. The lower altitudes of the zone are typically acacia parks, grass interspersed with bush country and scattered trees. The elevated grassy plains above seven thousand feet, such as occur on the Mau summit and on Kenia, are covered by a dense perennial growth of grass which crowds out all other vegetation.

The riparian vegetation is dominated by the yellow-barked tree, *Acacia verugosa*, which forms a narrow fringe of forest along all the streams. Associated with this are often trees of the rough-barked *Acacia stenocarpa*. In the lower levels of the streams on the nyika border the large red-fruited fig, *Ficus stuhlmanni*, is a conspicuous tree. In this region the immense fronds of the *Raphia* palm are often seen among the riverside trees. Throughout the Uganda region and also much of East Africa the tall feathery papyrus is the dominant swamp and watercourse plant and is characteristic of this zone. On the Nile, however, it covers large areas far down into the nyika to an altitude of fifteen hundred feet. At the higher levels of the veldt region the African clove, *Eugenia cordata*, grows abundantly on the banks of streams, and with it are occasionally associated a few willow-trees. A conspicuous riparian bush or small tree is the *Cassia didymobotrya*, with its perennial wealth of large yellow blossoms.

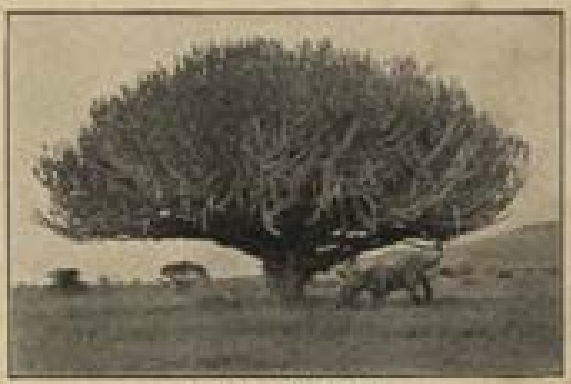
In East Africa proper, that is, in the Rift Valley and coast drainages, no forests occur in the high veldt zone, but in Uganda much of this zone is occupied by a tropical forest in character similar to that which spreads over the Congo basin. This forest is found in patches from its eastern extreme, the Kakumega forest at the base of the Nandi Escarpment westward to the Semliki Valley and the Congo

Euphorbia Forest, *Euphorbia ingens*
Amala River headwaters

Sausage Tree, *Kigelia aethiopica*
Nzoia River, B. E. A.



Flat-topped Acacia, *Acacia tenuispina*
Acacia Forest near Lake Naivasha



Candelabra Euphorbia
Loita Plains, B. E. A.

Haunts of Bongo, Forest Hog, and Red Duiker
Highland Forest on Mau Escarpment near Ravine Station

Giant Groundsels, *Senecio keniensis*
Alpine vegetation on Mt. Kenia at 13,000 feet

Dragon Tree
Dracaena ngaiba
Nyeri, West Kenia

Doum Palm
(Ivory Nut Palm) *Hyphaene coriacea*

CHARACTERISTIC VEGETATION OF EAST EQUATORIAL AFRICA

drainage. It is continued westward along the shore of the Victoria Nyanza around the west shore of the lake to Buddu and thence west to Ruwenzori and the Albert Nyanza.

The conifers and olives of the East African highlands are lacking in these lower altitudes, where the trees are chiefly *Sapotaceæ*, *Meliaceæ*, and other tropical orders. The forests are often composed of gigantic trees which grow in dense clusters, but in great variety of species. On the edge of the forest the brilliant red flowers of the *Spathodea* tree are often found associated with a fringing growth of red-berried sumac-like *Haronga* trees. In open spaces in the forest, fields of the wild banana, *Musa ensete*, occur.

The highland forest covers much of the high plateau region between the altitudes of six thousand and ten thousand feet. In British East Africa it extends roughly from Mount Kenia westward and southward to the Aberdare Range and the Kikuyu Escarpment above Nairobi, where it reaches its southern point. In the vicinity of Lakes Naivasha and Elmentaita it straggles across the Rift Valley to the great Mau forest. On the Mau Plateau the forest extends nearly unbroken from the German border northward to the latitude of Mount Elgon. The Elgon forest in its lower levels is connected with the Mau by way of the 'Nzoia River drainage. From the Mau crest the forest continues down the west face of the Nandi Escarpment, where it is continuous with the Kakumega forest, one of the tongues of the Uganda forest, which in its turn is continuous with the Congo forests in the Semliki Valley. The Kakumega and Uganda forests are, however, lowland and quite different in character from the highland forests, but the continuity of the whole area of tree growth has allowed

the extensive dispersal of forest animals. By using the shelter of riparian tree growth it is possible for an animal to travel within the forest from eastern Kenia westward to the Congo watershed. By this route several West Africa game animals, notably the bongo, giant pig, red duiker, and Abbott duiker, have reached the coast drainage of East Africa. Formerly this forest was much more extensive between the Aberdare Range and Mount Kenia, where large areas of the intermediate region have been deforested by the Kikuyu tribe in order to give them new soil for cultivation. Similarly destructive agricultural methods have separated portions of the Elgon and Nandi forests, which were formerly continuous. Isolated patches of this forest area occur in remote regions like the Taita Hills in the coast nyika. To the north of Kenia isolated patches of forest again occur on Lololokwi, Uarages, and many other peaks of the Mathew Range as far northward as Lake Rudolf. In the extreme southeast lie Kilimanjaro and Usambara on the German border, covered by an extensive forest area which is isolated by many miles of desert from the highland forest of Kenia. Westward in Uganda on the elevated slopes of the Ruwenzori Range the same type of forest exists above six thousand feet altitude. Ruwenzori is surrounded by, or rather its snow-crowned peaks are set in, a wide belt of highland forest. All of the highland forest is in the volcanic area and is underlain by lavas, chiefly trachytes and phonolites. Within the forest the soil is a black leaf-mould, but when this is removed a red clay soil is exposed, which is somewhat different in composition from that so universal in the nyika. Owing to the great quantity of ferric oxide in the soil, weathering converts it into a hard iron pan formation

which cannot again support tree growth, and on this account deforestation in the highlands of East Africa is attended by irreparable devastation. The only highland forests outside of this volcanic area are the isolated patches on the Taita Hills, the Mathew, Ruwenzori, and Usambara Ranges, which are in a gneissic region.

The forest is made up of a great variety of trees, only a few of which occur universally throughout its area. The yew, *Podocarpus milanjiana*, and the black olive, *Olea laurifolia*, are the only trees of this class which can stand the extremes of moisture existing between the moist east and the dry west slopes of the forested mountains. A wide-spread tree of the dry western slope is the Abyssinian juniper, *Juniperus procera*. A more important distributional factor than the division of the forest into a dry western and a moist eastern section is formed by the altitudinal assemblages of trees we find characteristic of the lower edge of the forest, the inner or true forest and the upper or timber-line edge of the forest. Characteristic of this lower edge of the forest, which fringes the open, grassy plains or continues as long tongues bordering streams down into the plains country, are the straggly, spidery *Croton elliottianus*, the *Brachylæna* (sandalwood), and the acacia-like *Albizzia fastigata*. A conspicuous tree of the forest edge is *Dombeya nairobiensis*, which is usually covered by a wealth of white apple-like blossoms. On the moist slopes we have added to these the large-leaved shrubby tree, *Macaranga kilimanjarica*, the columnar *Cusonia spicata*, tree-ferns, *Lonchitis pubescens*, and the peculiar tree-lilies, *Dracæna*. The poison-bush, *Acocanthera abyssinica*, the gray olive, *Olea chrysophylla*, the yew, *Podocarpus gracilior*, and the widely distributed juniper, *Juniperus procera*, are all

confined to the drier western forest edge. The grassy plains do not, as a rule, merge gradually into the forested area through an intermediate park-like country. The forest trees seem capable only of growing in masses where they are protected from the maximum quantity of sunlight. This massed condition of the forest is particularly in evidence on the Mau summit, where the grassy plains are bordered by a solid wall of trees as dense and as tall as the central parts of the forest.

The true forest is composed largely of two wide-spread trees, *Podocarpus milanjiana* and *Olea laurifolia*, and on western slopes often exclusively of *Juniperus procera*. Associated with these trees is found the giant of the forest, the camphor-tree, *Ocotea usambariensis*. Another tree of immense size and wide-spread distribution is the killer fig, *Ficus mallocarpa*, which in its youth twines about smaller trees, eventually enveloping them by the rapid growth of its knarled trunk and literally smothering them to death. The pillar-tree, *Wehea africana*, with its smooth white bark and mast-like trunk, is a conspicuous forest tree. A less common tree is the shaggy-barked *Walbergia ugandensis*. The large, glossy-leaved, magnolia-like tree, *Conophryngia*, is another wide-spread species in the forest. One of the large trees is the buttressed-trunked *Chrysophyllum*, which towers above the other trees and bears only a small crown of leaves at its apex. In certain parts of the forest the small, straggling *Trichoclaudus malosanus* trees grow in great abundance, especially in juniper forest. The commonest forest undergrowth is the prickly-leaved *Acanthus arboreus*. The bramble or blackberry, *Rubus*, is a common shrub in the forest, where it grows in thickets in the lower

altitudes. Several shrubs and small trees belonging to the *Rubiaceæ* are also common undergrowths. Great vines, several inches in diameter and many feet in length, form a network in some of the highland forest of the Mau and in parts of Kenia. The rubber-producing *Landolphia* vines often form a considerable part of this network.

The upper forest at timber-line is marked by a dense growth of bamboo of a peculiar high-mountain species, *Arundinaria alpina.* The bamboo forest occupies a zone about a thousand feet in vertical height, ranging from timber-line at ten thousand feet down to nine thousand feet. In this belt it grows to the exclusion of all other trees, the stems usually standing a foot or two apart and so close that it is quite difficult to squeeze through the forest without cutting a path. The only trees which are stragglers in this zone are *Podocarpus milanjiana* and *Olea laurifolia.* On the upper timber-line edge a large tree of the order *Rosaceæ* appears, *Hagenia anthelmintica,* which is characteristic. Practically no animal life is confined to the bamboo zone and very few animals live within its borders, owing to the soil supporting no undergrowth. The bamboo forms a desert waste between the life of the forest proper and the alpine regions. A narrow fringe straggles down into the forest along streams to an altitude of seven thousand five hundred feet.

One of the marked peculiarities of the African timber-line is the absence of dwarfing, which is so characteristic a feature of the tree-growth at high altitudes in our northern climes. The forest-trees grow fewer in numbers at the upper levels in equatorial Africa, but they are no smaller in size. Much of the dwarfing in the north is due no doubt to the

pressure of heavy masses of snow which must be borne for several months. Such a condition never occurs in tropical Africa, where the snow-fields are constant in area and far removed from the forests. Only the herbaceous moorland vegetation reaches the snow-fields, but does not mix with them.

The moorland which rises above the bamboo zone is a well-marked treeless belt extending from ten thousand feet to the snow at fourteen thousand five hundred feet. It is divisible into two lesser floral zones: a lower tree-heath belt ranging up to twelve thousand feet and a higher zone reaching to snow-line, characterized by the presence of the tree *Senecios*. The vegetation in the moorland zone is closely allied to that of the alpine regions of Eurasia and North America. Many of the genera and a few of the species which occur are common also to the north temperate zone. The great bulk of such plants belong to the orders *Rosaceæ* and *Ericaceæ*. The dominant shrub or small tree of the lower zone is *Erica arborea*, a species found also in the alpine regions of southern Europe. Several species of the wide-spread holarctic genus *Alchemilla* form the carpet of the moorland. *A. argyrophylla*, a stout, shrubby species, is the chief of these and grows in a dense mat one or two feet in depth over the entire area of the tree-heath zone. Another European genus, *Hypericum*, commonly known as Saint-John's-wort, occurs abundantly in the form of small trees at the lower or timber-line edge of the heath zone. *Hypericum lanceolatum* is an abundant tree, and its large golden flowers, which are borne in great profusion, give the lower alpine region a striking appearance. A small gray-leaved tree, allied to our sage-brush, *Stobæ kilimandscharica*,

appears with the *Hypericum* and the tree heaths in groves on the lower edge of the zone.

The upper half of the moorland zone is given a weird appearance by the prevalence of forests of tree groundsels, *Senecio keniensis*. This plant exhibits a striking variety of form ranging from a globular mass of large radical leaves, in appearance like a cabbage, in youth, through a thick-stemmed, barrel-shaped plant a few feet in height, and finally to a tall woody-stemmed, branching tree capped by immense club-shaped heads of dense leaves. Straggling forests of groundsel occur from twelve thousand feet to near the snow-line, but at the upper level they gradually dwindle in numbers and size, and those which reach the snow are only a few small, radical-leaved forms. Groundsels of several species are found throughout the world as common roadside weeds, but nowhere except in the highlands of Africa do they exhibit such large tree forms.

Associated with the groundsels are two species of lobelia, *Lobelia gregoriana* of the middle altitudes and a tall, woolly pubescent form, *Lobelia telekii*, which is abundant in the tree groundsel forest and continues up to snow-line. Both of these are peculiar in form and quite far removed from the lobelias of our gardens.

Throughout this upper alpine zone the *Alchemilla* is lacking, its place being taken by the heavy tussocks of a grass-like rush, *Ucinia*, which covers the hummocky, boggy soil to the snow-line, where it alone carries on the struggle with the cold. Growing everywhere over the whole moorland are found the daisy-like white and pink flowers of *Heliochrysum* in clumps and isolated patches.

The alpine vegetation of equatorial Africa is distinct

from that of the lower zones, and is closely allied to that of the north temperate zone, from which source it has evidently been derived. The heaths, hypericums, alchemillas, junipers, and brambles are the chief groups of northern derivation. It is possible that some of these reached East Africa from the Mediterranean region by way of the ranges flanking the Red Sea and the Abyssinian highlands. The region, however, is widely isolated from such a source, being without connecting mountain chains and having the great barrier of the Sahara Desert between. These northern species have, no doubt, reached central Africa at various times as strays, wind-borne, or by migratory birds or otherwise. It is scarcely conceivable that they could reach the region by progress through the lowlands at some time when the climate may have approximated that of southern Europe. Moreover, we have no evidence of the climate having been any colder to any considerable degree during any past period in tropical Africa. A small element of the alpine flora has ascended the mountains from the plains below. The groundsels, lobelias, bamboos, and grasses are examples of this sort. A strong argument of the accidental acquiring of the present flora is the fact that not a single northern type of mammal exists on the high mountains. This is not likely to have been the case had northern plants been able to reach the region by way of the lowlands. The species of mammals which occur at high altitudes have all been derived from the lower levels. None of these show more than a slight amount of specialization, notwithstanding the great climatic and environmental changes to which they are now subject. It is evident that the lack of any marked physical characteristics in the mammals of the

alpine regions show the species to have been of quite recent immigration into the region.

The affinities of the forest flora are with West Africa and to a lesser degree with Abyssinia and South Africa. The flora of the nyika is distinctly East African with scarcely any West or South African types, and forms a part of a wide-spread association from the Red Sea to the Zambesi. The tropical coast belt is similar in affinities to the nyika.

CHAPTER IV

CONCEALING AND REVEALING COLORATION AND THEIR RELATION TO NATURAL SELECTION

INEVITABLY any great scientific discovery contains, when first promulgated, some error; and equally inevitably some of the followers of any great leader of thought tend to push or twist his doctrines into fantastic extremes, and then to turn his thought into a system of fossilized rigidity. This happened to Plato and Aristotle; and it has happened to Darwin. The real work that Darwin did was in convincing practically all men of trained intelligence that the animal world, including man, has developed by evolution, not by an infinity of special creations. The law of evolution is as fundamental to our understanding of life as the law of gravitation to our understanding of the inanimate universe. It is less widely accepted merely because its discovery was more recent; the good people who on different grounds still reject it are merely occupying the same quite natural attitude that other good people of their stamp once occupied toward the then newly promulgated doctrine of gravitation. Less than a century ago the Catholic Church kept on the index all books that admitted that the earth went round the sun, and orthodox Protestant clergymen treated as heretical any doubt whether the world had been made in six ordinary days and was more than seven thousand years old.

But full recognition of the greatness of Darwin's achievement does not mean our acceptance of the immense importance which he ascribed to natural selection in bringing about evolution. Above all, it does not mean acquiescence in the views of his professed followers on this matter. In England and America, and largely in Germany, Darwinism has been made into a fetich by most scientific men, with results nearly as deadening to intellectual liberty as anything done in the name of theology by the mediæval schoolmen. In consequence outsiders have had to step in to correct the error of the professed scientists. The absurdity of the complacently arrogant materialism associated with the name of Haeckel, the showing that this new type of dogmatic intolerance is as unscientific as it is degrading, was left to Boutroux and Bergson, philosophers so thoroughly acquainted with physical science as to be able to perceive its limitations. The curiously unscientific mysticism of the Weismann school was also left to be exposed by men who were not professional scientists.

In this book we are dealing only with a tiny corner of the field which must be covered. But even in this tiny corner, what is above said applies. One of the series of phenomena to which especial prominence has been given in bolstering the theory of natural selection is that connected with the coloration (and certain details of the bodily form) of animals. We propose to deal with this in so far as it relates to the big game of Africa, using certain other animal forms for purposes of comparison and explanation.

By Darwin natural selection was treated as the chief, and by his more fanatical followers as the only, factor in evolution. Most American and English scientific men have

no real acquaintance with the writings of men like Cope, who with masterly ability set forth the claims of those who believe in the inheritance of acquired characteristics as likewise a considerable factor; it is only in France, where the outlook is broader, that Cope's eminence is recognized. In America and England natural selection as a complete or nearly complete explanation of evolution is still on the whole the fashionable scientific doctrine. Yet even in America and England there is now a wide-spread and constantly growing belief that, although natural selection undoubtedly plays a great part in the survival or extinction of species, it only plays a minor part in the creation of species, and that none of the explanations hitherto advanced of the creation of species is by itself sufficient to explain, and indeed that all of them together are not sufficient to explain, the major part of the phenomena.

By far the most satisfactory recent book on the subject is "The Making of Species," by Dewar and Finn. The authors keep ever in mind Huxley's statement that "Science commits suicide when it adopts a creed." In other words, they try not to pin their faith to dogmas and, above all, not to accept one explanation as true merely because they have no other to offer. Doubtless the greatest service to science is rendered by the man who can give the right explanation of phenomena. But the most serious injury is done by the man who persuades people to adopt the wrong explanation. In our present state of knowledge it is a prime necessity that we shall be continually saying: "I do not know." As yet we *know* almost nothing as to how species originate. The theories of closet specialists help us very little. Experiments carried on under wholly artificial con-

ditions, as on animals in captivity, help us more, but must be most carefully scrutinized or they will lead us into error—as has been well shown by McAtee in his paper on "The experimental method of testing the efficiency of warning and cryptic coloration in protecting animals from their enemies," in the Proceedings of the Philadelphia Academy of Natural Sciences. Further help, indispensably necessary, must be rendered by first-hand observations of species in their natural surroundings and in their natural conditions. We propose to render a very little help in this way, by recording observations, far from being as extensive as they should be, but faithful and painstaking as far as they go. We wish to give our actual field experiences and observations on the coloration of the big-game animals of Africa, comparing it with the coloration of various other animals, especially the big-game animals of North America, with which we are also familiar at first hand.

The neo-Darwinian ultra-upholders of the natural selection theory, ranging from Mr. Wallace through Professor Poulton to Mr. Abbott Thayer, all explain almost all the phenomena of animal coloration and of the development of appendages on animals by the theory of natural selection. They hold that almost all the details of an animal's coloration, etc., have a direct utilitarian purpose, which they name, and a particular kind of usefulness, which they point out; and they treat these as survival factors. But as regards many cases they differ from one another, and indeed contradict one another and take directly opposite views concerning what this useful function is. Mr. Wallace, for instance, believes that many striking markings of a highly advertising quality serve as recognition marks between

individuals of the same species. Mr. Thayer considers these same markings as obliterative, as concealing. Now, of course, both these theories cannot be true; as a matter of fact on this particular point, while we can say that the theory of Mr. Wallace is not proved and is probably incorrect, but is possibly true, we are obliged to say of Mr. Thayer that his theory is obviously without any foundation in fact and ought not to need serious discussion. We mention it at all merely because scientific men of reputation, like Professor Poulton, and scientific journals of standing, like the *Auk*, have given it solemn, and at times favorable, consideration. Mr. Wallace's view that the white tail of a running rabbit serves as a warning or directive mark must be seriously treated; but Mr. Thayer's theory that this white tail hides the running rabbit from a fox, snake, or weasel ought not to need any treatment whatever, serious or the reverse.

Mr. Wallace's theory is that concealment is the general and ordinary purpose served by the coloration of animals —of African antelope, for example—but that their face and rump markings, and in the case of African antelopes their horns, serve as recognition marks, to enable the individuals of each species to recognize one another, and above all to enable those of opposite sex to be sure that they mate within the species. We think that the facts observed in the field do not bear out these theories. Mr. Wallace gives pictures of the horns of twelve species of African antelope to show that they serve as recognition marks. In nine of the twelve species—kob, waterbuck, lechwi, gazelle, etc.—these horns are confined to the male, and assume their characteristic shape only when he is adult. It seems a very

wild theory indeed to suppose that the old males need recognition marks, while the female and young males do not; and not one fact has been advanced in support of the theory. All the facts are the other way. A waterbuck or kob will recognize a hornless cow or a horned bull of the same species with equal facility, and at a distance such that the horns cannot be distinctly seen. A tenth species mentioned by Mr. Wallace, the hartebeest, has horns in both sexes; but they are relatively short, whereas this particular antelope is of extraordinary shape and can be recognized by its shape alone at such a distance that the horns cannot be made out at all. It does not seem wise to advance such a theory as this concerning antelope horns as recognition marks when no observed fact supports it and many observed facts are inconsistent with it.

As regards the conspicuous face and rump markings there is room for argument. We do not, however, believe that these markings serve any purpose of recognition for sexual purposes. Cases of melanism and albinism are well known in many animals, often appearing only in certain localities. White deer and white waterbuck are not infrequent. In every case the animal seems to associate with others of its kind precisely as if it were normally colored; and if a female it will frequently be found with a young one, usually of the ordinary color. Black and brown bear cubs, black-maned and light-maned lion cubs are found in the same litter. Where such startling color patterns as are implied in being white all over or black all over totally fail to confuse individuals of the opposite sex as to what species the animal belongs to, it seems unlikely that they require guidance in such matters by the display of a few spots of white or black

or a slightly different tinge to the coat. Terns which have been dyed indigo or carmine and turned loose are soon accepted by their fellows, and even by their mates, on the old basis. Mr. Spencer Trotter found a male scarlet tanager breeding although the hind back and the belly were green; but the startling aberration in color had not confused its mate. In one herd of topi we saw an individual with a blazed or white face, like that of its relative, the South African blesbok; but the other topi treated it precisely like one of themselves. Animals with dichromatic color phases, like the red and gray phases of the American screech-owl, and of the cougars we have collected in the Colorado and Arizona mountains, mate together wholly without regard to color. Still more striking are the facts in the case of the white-withered lechwi and the white-eared kob. These animals belong to very closely allied genera and are of about the same size, and they dwell in the same neighborhood along the White Nile—one in the swamps, the other in the dry plains alongside the swamps. Sometimes these herds meet on the edges of the swamps. The females are so alike in shape and color that it needs an inspection close up, including a look at their hoofs, to tell them apart. If animals really needed striking recognition marks to enable the individuals of one sex to recognize the individuals of the other sex of the same species, there could not fail to be numerous hybrids between the kob and lechwi. As a matter of fact, although both species are abundant in the same region, such hybrids never occur, or occur so rarely that they have never been observed. It is evident that the sexes have no difficulty whatever in recognizing one another and discriminating against the animals

of the opposite sex belonging to the other closely allied species.

All these facts are fairly conclusive that there is nothing in the theory so far as sexual recognition is concerned. That there is also very little in the theory as regards ordinary or non-sexual recognition, we have no doubt. A roan antelope, for instance, has bold face markings—an eland, in some of its forms, none; but there is evidently no more difficulty about recognition in one species than in the other. Dewar and Finn believe that the rabbit's white tail is of no use, and advance substantial reasons why it cannot serve as a warning to other rabbits. Nevertheless, to us it does seem as if a conspicuously exhibited white tail must serve some functional purpose of advertisement where there is the kind of display that we see in the various hares, the white-tailed deer, and the antelope squirrel. Mr. Seton produces facts to show that it may serve as a guide to the young. The prong-buck of America does, when excited or curious, raise the hair on the white rump with a chrysanthemum effect, so that it flashes in the sunlight; and it is *possible* that this may enable the pronghorns to recognize one another at a distance of a mile or two—although, as their bulging, telescopic eyes are better than those of any other American game, they can probably recognize one another's ordinary markings by vision at such a long distance that the possession of another method of recognition seems a matter of surplusage. Moreover, Mr. Nelson's exceedingly interesting study of one species of southern jack-rabbit seems to prove beyond question that, for whatever purpose, the animal does deliberately make use of directive coloration. This jack-rabbit is concealingly colored when crouched

motionless and trusting to concealment. When it runs it hitches its skin so as to bring the white of the belly up on the side toward its disturber—a most remarkable example of seemingly purposeful advertising coloration.

So much for recognition marks. But by the ultra natural-selection men the chief stress is always laid on concealing coloration. Instead of treating concealing coloration as something which is sometimes present and sometimes absent, which is sometimes useful and sometimes not—in other words, instead of treating it from the scientific standpoint of the observer who prefers rather unsatisfactory and partial truths to brilliant and comprehensive falsehoods—men like Professor Poulton and, above all, Mr. Thayer treat the extreme neo-Darwinian theory of protective or concealing coloration as a law of nature. It is nothing of the sort. It is at best, as Dewar and Finn point out, a working hypothesis which is useful as throwing light on certain phenomena, and which does apply in a large number of cases. It breaks down if the attempt is made to apply it universally or nearly universally, and is demonstrably false as applied to all sexes and ages of many thousands of species of the higher vertebrates, mammals, birds, and even reptiles (to speak only of species which we have personally studied). Professor Poulton has conducted a number of experiments under highly artificial conditions, and has drawn certain conclusions, partly from these experiments, but much more largely from what can hardly be called anything except closet theorizing. Mr. McAtee, in the paper quoted above, has shown why these particular experiments and conclusions have small value; this being done as an incident to showing why most experiments under artificial conditions have small value.

The best examples of experiments carried on under conditions so artificial as to make the experiments not merely useless but misleading, and of conclusions which are of even less value than the experiments, are furnished by Mr. Thayer. Mr. Thayer's experiments have the value that attaches to puzzle-pictures in the Sunday papers. They show that by the exercise of ingenuity it is possible to find for every mammal or bird, of every conceivable type of coloration, some combination of light, background, and surroundings in which it will be inconspicuous. Mr. Thayer has recorded the results of his observations in a beautifully printed and illustrated book, containing a great many photographs of live wild birds and mammals taken by other men, some photographs of dead or tame animals or of artificial imitations of wild animals taken by himself, and some pictures painted by himself. The latter are designed to show that peacocks are concealed from their enemies because they are colored like the sky and the foliage, wood-ducks because they are colored like water-lily flowers and leaves, blue jays because they are colored like shadows on snow (most blue jays spend most or all of the year where there is no snow, and against the snow their coloring is revealing hundreds of times for once that it is concealing), and spoonbills and flamingoes because they are colored like clouds and sunsets—it being supposed that sharks and crocodiles, and the minute gasteropods on which the flamingoes feed, are misled into believing that the sun is always setting whenever flamingoes are near. It is a little difficult to develop the theories for which Professor Poulton stands to a higher point than Professor Poulton has developed them; but Mr. Thayer has accomplished the feat. He

upholds the views that the coloration on practically all animals (including even the most vivid and advertising colors and patterns) is really concealing—not that it was concealing in some remote geologic past, but that it is actually concealing to-day; and he attributes this to "natural selection, pure, simple, and omnipotent." He shows both daring and versatility in his use of facts. Skunks, crows, scarlet tanagers, white herons, and the like he courageously declares to be concealingly colored. Nor is he daunted when his theory requires him to show that the same sky is of two diametrically opposite hues, so that it may, under the same conditions, harmonize both with the deep blue of a peacock's neck and the dazzling white of a prongbuck's rump. He wishes to show that each object fades into the sky; so he paints in colors the picture with the peacock in it, making its neck and the sky of the same brilliant azure tint; and he leaves uncolored the picture with the prongbuck in it, so that in this case the sky and the rump are both white. What would happen if the two animals changed places and wandered each into the other's sky, he does not explain. Professor Poulton, presumably speaking for and to the leading scientists of Great Britain, highly praised the scientific worth of this book. It seems a pity that he could not have included in his praise the equally striking contention of the late Brother Jasper that "the sun do move" round the earth.

Professor Poulton's theory, developed both by him and by Mr. Thayer, is that the eyes of a creature's prey or adversary take into account the most minute details of coloration. This may be so in the case of such an animal as a tree-toad. It is certainly not so in most cases, how-

ever. With multitudes of animals no notice is taken of any prey unless it moves, and when it moves all small detail is lost. A lizard will pay no heed to the most brilliantly colored insect when motionless and will seize anything that moves, even when itself at the moment in jeopardy. I once watched a lizard poised motionless by a large motionless insect on a small tree; I moved my hand to capture the lizard, which caused both the latter and the insect to shift positions; whereupon like lightning the lizard seized the insect, and with its mouth distended by its prey it dodged round the tree trunk to avoid its foe. Any angler could enlighten doubters as to the fact that no resemblance in minute detail is needed in order to get fish to take a fly. From time to time fly-fishers experiment with artificial flies showing this minute resemblance, only to return to the regulation flies, which certainly do not minutely resemble any known insect. A trout which is eager after a "red ibis" or "brown hackle" must possess a splendid visual disregard of minute detail.

What is true of wild fish in a state of nature is also true of wild birds in a state of nature, as is proved by the experiences of shore-shooters with decoys, both as regards water-fowl and as regards bay-birds or shore-snipe. The ultra protective-colorationists lay stress on the great importance of the "ripple marks" on the flanks of ducks, and the exact tint of the legs of waders, and other minute details, from the standpoint of the creatures that look at them. Well, the conduct of water-fowl and shore-birds and of birds of prey toward all decoys shows that these minute details are of no consequence whatever until the birds are so close that they could by no possibility have either any concealing or

any revealing value, and that even then they may be completely ignored. By actual experience shore-shooters have found that after a certain rough resemblance to the wild bird has been attained further painting of the decoy to make the resemblance minutely accurate is a waste of time and brings no advantage. Instead of legs the shore-bird decoys stand on sticks which are thrust into the sand. The duck decoys which bring best results are commonly painted so roughly that none of them would for a moment be accepted in even the cheapest book or collection as fit copies of the originals. Yet the species of water-fowl and shore-snipe which decoy at all will come to these decoys as readily as to any others, and often will light among them and swim or walk round them for some minutes. For unknown reasons certain ducks and waders will not come to decoys; but the species that do come evidently fail to notice the minute details, and some of them fail to notice any details, coming down to decoys which are mere caricatures. Birds of prey sometimes strike at decoys. I have myself known an eagle to stoop at decoy ducks, and when it failed with the first one attacked, to repeat its swoop at another, evidently not understanding what had happened. There could be no better proof of the unimportance of detail in the eyes both of at least some of the birds that prey and some of those that are preyed on under the ordinary conditions of their lives.

There are similar facts to be adduced regarding mammals. In Africa, in former times, bushmen, customarily, and at least one white man, Mr. Jackson, the present governor of Uganda, on one occasion, rigged themselves as artificial ostriches and thereby were able to approach gazelles

and other animals closely, although, of course, their legs bore no earthly resemblance to ostrich legs, and indeed the neck and head were all that was really simulated. East African natives sometimes equip a donkey with the scalp and horns of a hartebeest and use it with success as a stalking-horse; which goes to show that oryx, zebra, hartebeest, and the like pay as little heed to detail as any ducks that ever were tolled to the rudest wooden decoys. A hunter I knew in Montana many years ago was once bringing home part of the carcass of a deer on his back, when he was pounced on and knocked down by a cougar. As soon as the cougar realized that it had to do with a man, it drew back; evidently it supposed it was attacking a deer; and in the stupid boldness of hunger it paid so little heed to detail as to make its assault in spite of the slow pace at which the man was moving and the wholly unnatural position of the deer.

Of course, it is unwise to generalize in confident fashion on a few data; but as far as they go these experiences with fish, birds, and mammals tend to show that vertebrates pay no such heed to minute details of color and shape as is assumed by the ultra neo-Darwinians in supporting their theories of the all-sufficiency of natural selection in originating species, and of the extraordinary and well-nigh universal potency of concealing coloration as a survival factor as regards all beasts that prey or are preyed on. As for insects, any one who has ever seen a hornet or wasp trying to catch flies in a tent and continually pouncing on any black spot must realize that their vision is so poor that they cannot take in details of even an obvious kind.

Boutroux has dwelt on the need of using common sense in testing the extravagances of scientists no less than the

extravagance of theologians. Really, there ought not to be need of appealing to anything except common sense when we are asked to consider some of the vagaries of the ultra concealing-colorationists. One of their latest fads is that white is a concealing color, even at night; that beasts with white sterns, like so many ruminants and rodents, are concealed from their foes at night by their white sterns because white is invisible against the sky-line. War-ships in time of war are most often seen against the sky-line, and are always so seen by torpedo-boats, which it is the especial object of the big ships to elude at night. Well, no naval officer in his senses would dream of painting his ship white so as to escape observation at night under any normal conditions; as soon as war comes all ships are painted some neutral tint, because as a matter of actual experience every one recognizes the fact that, taking into effect moonless and moonlit nights and all cloud effects and weather conditions, white is on the average the most revealing or advertising of all colors at night. In the old days, on the Western ranches, we always preferred white horses for night work whenever it was desired to be conspicuous. Scientists ought not to show less common sense than naval men and cow punchers.

Of course, every color and every conceivable combination of colors may under some circumstances be concealing or revealing, even although under ordinary conditions the reverse is true. It is a question of averages. There are nights when no color can be seen, and then the color is a negligible factor. There are other nights or portions of nights when under some given conditions of background or cloud effect or position of the moon, black or brown or

gray or white may each in turn be more conspicuous or less conspicuous than any of the others. But half of the hours of darkness are moonlit, and if the moon is very bright, white, black, and the bold colors generally, are almost as visible as by day. Taking into account moonlit and moonless nights, starlit and starless nights, clear and stormy nights, and all the different cloud effects, and the probable backgrounds of sky, soil, and vegetation, white is on the average by all odds the most conspicuous color at night, and the neutral tints, the dull grays, drabs, and yellow—browns are the least conspicuous when seen from the ordinary view-point of the ordinary foes. The white rump of a standing or running prongbuck or black-tail deer or bighorn is under most conditions of a highly revealing or advertising value at night as well as by day; and the same is true of a running white-tail deer or rabbit. We state this as the result of innumerable personal observations of these animals when in their own homes under normal conditions.

Two of Mr. Thayer's "proofs by experiment" may be mentioned to illustrate the worthlessness of experiments when carried on under the influence of a perverse obsession. Mr. Thayer's thesis is that *all* forms of coloration are concealing; but next to countershading he considers "ruptive" and "secant" coloration schemes as most potently concealing. He regards vertical striping as a type of concealing coloration of peculiar potency, brought about purely by the "omnipotent" power of natural selection, because of its survival value. He adduces the striped African antelopes (all of them tragelaphs, except one duiker) as cases in point. He records one experiment which he asserts proves the truth

of his assertion. At a meeting of the American Ornithologists' Union in Washington, as he relates, he showed to forty naturalists "a small, stuffed deer (a South American species) that wore from its dorsal line down its sides two white stripes in imitation of those of certain African antelopes." He states that at ten yards' distance these (artificial) stripes rendered the deer invisible to the "forty naturalists," but that when they were removed and the deer left colored as it actually was colored by nature it became clearly visible. Apparently neither Mr. Thayer nor any one of the "forty naturalists" was struck by the sufficiently obvious fact that, according to his own account, *he proved that the actual coloration of the deer was not concealing, and that it had to be concealed by artificially giving it a coloration it did not in nature possess.* He showed, therefore, that nature did not give the deer a concealing coloration, and that Mr. Thayer himself had to step in to supply the omission. In other words, he proved that natural selection had not been "simple and omnipotent," and that concealing coloration was not a survival factor; that, if it played any part in protecting the deer, it was a minor part as compared to other factors, such as habit and cover. Now, only one in ten of the species of African antelope has stripes; very few have spots. No antelope outside of Africa is striped. None of the deer have stripes, and very few, when adult, have spots. The small ruminants, such as the one to which Mr. Thayer thoughtfully gave the concealing coloration it lacked, include the South American brockets, the Asiatic muntjacs, and other little deer, and antelopes like the duikers, dikdiks and reedbucks. All of these are unstriped.

Mr. Thayer's experiment, therefore, proves, so far as it

proves anything, either that stripes are not concealing, or that if they are concealing then natural selection has only been able to develop them in one-twentieth of the animals to which they would have been of benefit. Nor is this all. Of the groups of African antelopes which carry stripes, two, the bushbucks and the elands, seem to be slowly losing them. The centre of development of these two groups was probably the African equatorial forest, from which both have spread eastward and southward. The farther from the forest they go the less evident the stripes become, until in the South African eland the stripes completely vanish, and in the males of the East and South African bushbucks they practically vanish. Yet where conditions happen to be identical the practically monochrome bushbuck and eland prosper as well as their striped and spotted kinsmen. In the Lado we found the non-striped duiker even harder to see than the harnessed bushbuck of the same habitat. In the dry bush of East Africa the unstriped gerenuk is as difficult to make out as the striped lesser koodoo of the same habitat. Considering all these facts, the conclusion seems inevitable that, on the whole, the striped coats confer no advantage and are if anything slowly dying out, although not in consequence of natural selection. The fact probably is that as regards deer and antelope habit, or the combination of habit and cover, is the survival factor of such overwhelming importance that the precise color of the coat is of *no* consequence one way or the other. This is certainly the case at the present time, and it was *probably* the case as regards these particular animals since a comparatively remote geologic past.

The coloration of most groups and genera of African

big game is very ancient and of long standing and is often more constant than the osteological and horn characters upon which the genera are usually based. Such fixity must have been produced by color inheritance through countless generations. Present environment, therefore, acts very slowly, if at all, on the color scheme; its only appreciable effect being usually one of tone or shade on the coloration generally, and this effect being *probably* due to the inheritance of acquired characteristics rather than to natural selection. One of the strongest proofs of the long-standing nature of color pattern is found in the young of such striped game as zebra, koodoo, and bongo, which show absolutely down to every minute detail the color pattern of their parents. There is in these early stages no clew to the remote ancestral coloration of the race, nor is there moreover in the earliest fœtal stages in which color is assumed any change from the adult livery in essential pattern. But the young of the unstriped eland and unspotted and unstriped bushbuck do show traces of ancestral spots and stripes.

The other "experiment" of Mr. Thayer's to which I wish to refer is that made with imitation oryx heads and zebras. He wishes to show that its stripes protect the zebra when it is among the reeds at a drinking-place; and that the bold black and white markings on the head of the oryx likewise "simulate reeds" at a drinking-place. He contrasts each picture with a picture of the same animal, or animal's head, colored gray or brown and countershaded in ordinary fashion. He points out with triumph that (in his pictures of artificial animals) the whole zebra in one case and the oryx head in the other are more diffi-

cult to see than the monocolor countershaded animal and animal's head; he announces that this proves that the stripes on the zebra, and the bold black and white markings on the oryx head, are striking instances of concealing coloration—developed by natural selection to insure the safety of the animals from beasts of prey when they go to drink.

This "experiment" has an interest of its own, it is true, but only as reflecting light on the worth of all such experiments. Mr. Thayer knows nothing whatever of the habits of African game or he would not make such a contention. Zebra and oryx are beasts of the open country. Neither ever goes into reeds except when approaching a drinking-place, and then rarely. Their habits, and the habits of other plains game—hartebeests, wildebeests, eland, gazelle, topi, kob, even impalla—are such that it is absolutely impossible for any hunter, beast or man, to avoid seeing them when they come to water. The animals with striped bodies and the animals with gray or brown countershaded bodies, the animals with boldly marked heads and those with nearly monochrome countershaded heads, all live under the same conditions, all have precisely the same habits on approaching drinking-places, and at such times none of them are either helped or hurt by their coloration patterns.

In fact, this particular proposition is merely advanced as a phase of the theory that the coloration of the various animals of the open plains, which is obviously of no use in concealing them while they are feeding or resting, may be of value in concealing them when they come to drink. There are no facts advanced to support this theory; and, on the facts actually observed, there are two conclusive objections.

The first is that such animals as the wildebeest, topi, hartebeest, and zebra, which have exactly the same habits and drink at exactly the same pools, are so differently colored that it is possible to maintain the thesis of concealing coloration as to one only by insisting that the others are advertisingly colored; and yet all prosper equally well, and obviously no one of them, as compared to the others, is in any way either helped or harmed by its utterly different coloration, or has altered its life to take advantage of it. When the dark, nearly monocolored, countershaded hartebeests, and the nearly monocolored, inversely countershaded topis, and the striped zebras come to water (or feed or rest) together, or in similar places, it is, of course, evident either that the coloration of one advertises it and puts it at a disadvantage as compared with the others, or else, what is undoubtedly the fact, that neither the so-called advertising nor the so-called concealing coloration has any effect one way or the other.

The second and still more conclusive objection to the theory is that the actual habits of the animals when they come to drink are such as to render it impossible that their coloration can have any, even the slightest, effect in concealing them at such times. Motion, unless of an extremely stealthy and skulking type, at once reveals any animal, without regard to its coloration. We have seen white-tail, and more rarely black-tail, deer skulk with such stealth as to tend to escape observation; and in Africa it is possible (we say possible, not probable) that some of the cover-loving game—bushbuck, duiker, and dikdik, for instance—may skulk and take advantage of cover, and even perhaps profit by their coloration, as they come to drink; of this we can-

not speak. But we have carefully observed the habits of zebra, eland, oryx, wildebeest, hartebeest, topi, kob, impalla, big gazelle, and little gazelle. All these animals come to water in the same manner. They not only make no attempt whatever to hide while approaching the water, drinking, or leaving it, but their methods of approach are such as to make it impossible for them to escape the observation of the dullest beast of prey that has eyes at all. They, if anything, avoid cover. They advance in the open. They come stringing toward the pools or streams in long files, occasionally bunching together.

Where there is no cover at the drinking-places, they may come to them alone or in small parties. Where there is cover, or where there is much fear of lions, the different species of a given district may come singly or in small parties, or they may join and come to the drinking-place in a throng, as has been described by Sir Samuel Baker, in his "Nile Tributaries," and by Doctor A. Berger, in "Afrikas Wildkammern." In either event, the animals neither hide nor seek to take advantage of cover during the approach. They walk forward, halt to look around, and then walk forward again. They are always on the watch. Occasionally they wheel and gallop off, either in mere panic or perhaps (as has been suggested by Mr. Hodson, in "The Great Thirst," as to roan and sable antelopes) to lure any foe to show himself. Their whole concern is themselves to detect the presence of any lurking enemy; they make no effort to escape the observation of this lurking enemy. If they are very thirsty, and yet suspicious of the lion's presence, they will often hover about the neighborhood for many minutes at a distance from the pool. At last they may charge madly down

in a body to drink, gulp a few mouthfuls and retreat at full speed before their thirst is satisfied, returning again in a few minutes. Colonel Patterson has described oryx performing this manœuvre, and also once saw it performed by a mixed herd of zebras and hartebeests. Again and again we have seen hartebeests and zebra come to water. They always travelled in the open for at least part of the time, and halted and stood at intervals as they approached the pool or stream; sometimes they would suddenly wheel and gallop off for fifty or a hundred yards; they were very noticeable as they walked down to drink and while drinking; and they then at once jumped out of the stream bed and cantered away to some open spot before beginning to graze.

Never once did we see a zebra, oryx, hartebeest, or any other game animal of the plains approach or stay at water save under circumstances that made it impossible for any watching wild beast not to see it. The zebra or antelope trusted for its safety exclusively to its sharp senses, watchfulness, and agility; its coloration was a negligible factor one way or the other. We have seen game hang about in the neighborhood of the water for an hour, shifting position and watching before venturing to drink. Game never remains in the cover near the pool for any time after drinking. It is well to look at Lord Delamere's photos of oryx going to drink, in Lydekker's "African Game"; Dugmore's photos of hartebeest and waterbuck; Akeley's photos of impalla; Schilling's photos of zebra and gazelle; Rainey's photos of baboons, rhino, gazelle, oryx, zebra, and giraffe, sometimes all drinking together. A brief examination of these photographs shows that when the big plains animals approach, or are at, the drinking-places no coloration has or

can possibly have any effect in concealing them from their foes. While drinking they are apt to start and look round. They never lie down near the water; they never stand motionless in cover near the water save for a few moments between their forward moves; when they have satisfied their thirst they move back to the open flats on which they dwell; and the long tails of the zebra and oryx are perpetually in motion and would of themselves catch the eye. In short, the habits of the zebra and oryx are such that at the only times when they are in the reeds it is an absolute impossibility for any watching beast of prey to fail to discover them, and no coloration, whether advertising or concealing, would either help or hurt them. This applies by day; it also applies by night save when the darkness is such that no coloration can be seen at all.

But this is not all. Mr. Thayer "proves" in his "experiment" that relatively to the variegated oryx and zebra a practically unicolored countershaded animal would in the reeds be revealingly colored. Well, it happens that in Africa there is an animal, about as large as the zebra or oryx, which nearly fulfils Mr. Thayer's definition, which is of a nearly uniform countershaded color on head and body, and which does often live in the reeds. This is the waterbuck. It often spends over half its time in the reeds and near the water's edge, standing and lying down. Mr. Thayer "proves" that the zebra and oryx have a coloration which in the reeds is far more concealing than is the coloration of the waterbuck when in the reeds. Yet, as a matter of fact, the waterbuck often dwells in the reeds and the zebra and the oryx never do. The actual facts are directly the reverse of what Mr. Thayer supposes them to be. Not

only is his elaborate theory (based purely on artificial experiment) unsupported by one shred of evidence, but it is shown to be the direct reverse of the truth by the simple expedient of studying the facts in the field. Yet it is on just such theories as this, backed by just such experiments, that the ultraselectionists rely for support concerning much of their contention about concealing coloration. If Mr. Thayer in this instance were sound in his premises he would have proved the exact reverse of what he announced he has proved; for he would have proved that natural selection had developed a revealing coloration in the animal which lives in the reeds. As a matter of fact, what is really proved is that the coloration of these animals has no survival value one way or the other.

Experiments of such an artificial character are usually of doubtful value; carried on as Mr. Thayer has carried them on they serve merely to darken understanding. No closet or laboratory experiment begins to approach in value first-hand field observations by a competent man. Mr. Charles Sheldon's preliminary study of the white and black mountain-sheep, in his "Wilderness of the Upper Yukon," affords a model of what such a study should be, and, when read, there is no need further to explain why no amount of ingenious closet guessing can take the place of trained first-hand observation of animals in their native haunts undertaken, not to twist facts into the support of a theory, but with the ability and purpose to find out the truth. His conclusion concerning the subject with which we are dealing is that the colors and coloration patterns of these northern sheep are not caused by natural selection of their protective values—that they are not survival factors. On the whole,

it appears that in both the black and the white species they represent revealing rather than concealing coloration.

But we must not forget how many men are unable to observe clearly and understandingly, even when their intentions are excellent. This is true even of savages whose life is passed in following game, and of white men who make hunting a business. Among savages, whose very lives depend upon their knowledge of the game, it is extraordinary to realize the extent to which this real knowledge is mixed up with not only inaccurate personal observation, but inaccurate inherited traditions, and the love of pure magic and mystery. Hunting savages always talk much about the game round the camp-fires; and the wildest legends are mixed with acute and accurate observations, all told with the same implicit belief. Our own Indians always took this attitude toward deer, antelope, moose, elk, but preeminently toward the buffalo, bear, cougar, and coyote, animals concerning which the average Indian hunter was wholly unable to divorce actual observation from mythology. The same thing is true in Africa even of such acute observers as the forest-dwelling 'Ndorobo, while the ordinary savage, even of the hunting tribes, will believe utter fables, and even persuade himself that he has witnessed such impossibilities that his statements must be accepted with extreme caution. As for the ordinary white hunter, let any one read what Selous tells of the worthlessness of the views of even experienced Boer hunters as to such elementary points as the number of species of rhinoceros and lion, and the difference in ferocity among these (purely imaginary) species. We ourselves have had precisely the same experience with Rocky Mountain hunters in getting them to tell about

grizzly bears and cougars; good, competent men would tell us about cougars eleven feet long, and about the wide difference in behavior and ferocity between "blue" and "red" cougars (merely slight color phases of the same species, as with red and gray screech-owls) and the similar differences between "bald-face," "roach-back," and "silver-tip" grizzlies—all of them the same animals. In a really good book on the tracks of American game, by a veteran professional hunter, there is an account of a purely mythical animal, the "fan-tail deer," of Montana and other parts of the West; and again and again old hunters insist upon the existence of the "ibex" which they have themselves seen and even killed; yet the smallest scientific inquiry at once and invariably proves the fan-tail to be nothing but some small white-tail, and the ibex to be a young mountain ram.

We need not wonder that unread men with untrained minds take such positions; for educated men, good observers, frequently record observations as diametrically opposed to one another, and draw from one set or the other false conclusions. We are not in the least blaming these men; doubtless we would do just the same ourselves if we had not been put on our guard. We are all of us feeling our way and must profit by both the discoveries and the mistakes of others. Too often the open-air naturalist, the out-of-doors observer, backs up his erring closet brother by observations which really represent nothing but the tendency to see what the man has been told to look for. The hunters and explorers unconsciously make observations in accord with what they have been taught to expect to find in such a matter as concealing coloration. At one time they are told that a general uniform tint is concealing,

and they see things accordingly. At another time they are taught the extreme efficacy of stripes, and accordingly any time a striped animal proves hard to see, the fact is stored away in support of the theory.

In Sclater and Thomas's "Book of Antelopes," Lieutenant-Colonel Olivier says of the lesser koodoos of the Somaliland region that they are found in "thick, scrubby jungle," and he dwells on the way in which the stripes on the slaty gray of their coats make them "harmonize with the foliage" and "exactly reproduce the checkered shade of sunshine through leaves." Writing of the gerenuk of the same regions, Donaldson Smith says: "Their solid reddish brown color renders them almost invisible . . . they almost always keep to the bushes." The two observations seem inconsistent; but they are not; it is only the implied explanations that are inconsistent. A solid reddish-brown, and a slaty gray with white stripes, are not in the least alike; yet the wearers of both coats, in substantially the same country, are exceedingly and equally difficult to see—as we ourselves discovered on the Guaso Nyiro, where both species are found under substantially the same conditions. The fact is that it is neither the stripes nor the absence of stripes, neither the reddish-brown nor the slaty gray, that is concealing. Any color, or combination of colors, any solid-colored coat or striped or spotted or varied coat—save, perhaps, some highly advertising color like pure black or pure white, or such a combination as a black back and a white belly—is concealing *in such cover to an animal with such habits.* Cover and habit are the essentials; the exact shade of, or amount of variety to, the coat is of no consequence. Natural selection cannot have produced either coat under pres-

ent conditions; the utmost it can have done is to set wide limits, between which any color or combination of colors may be developed. Under bright sunlight in such bush and jungle as that in which gerenuk and lesser koodoo are found, separately or together, the play of light and shadow is such, the checkered pattern of sunshine through leaves on either solid or striped or spotted bodies is such, the bright colors and deep shades of the accidented landscapes are such, the vistas are so numerous, so superimposed on one another, and of such varied length and breadth, and the amount of interposed and surrounding and backing twiggery and foliage is so great, that any motionless body of any fairly neutral tint, whether solid or varied, is so difficult to make out that the exact shade and the exact character of the markings are of no consequence whatever. Gerenuk or lesser koodoo, duiker or bushbuck, leopard or lioness—all dwelling in the same surroundings, are equally well concealed, whether their coats are striped or spotted or uniform.

It is curious to see how even first-class hunters, if unaccustomed to analyze their observations, have been completely misled by failing to understand this simple fact; namely, that normally no animal is conspicuous in an ordinary landscape, for such a landscape is broken and accidented, is flooded with light and varied with shadows, contains innumerable vistas and obstructions, and is filled with a myriad color tones. Naturally in such surroundings any animal of any color is difficult to make out; and when he has recognized this fact, the average observer tends to believe that it is the animal's coloration, and not the landscape, that is responsible.

One of the queerest claims of the concealing-coloration

theorists is that the giraffe is concealed by its coloration. (In reality the giraffe is not concealed by anything.) The advocates of the theory attribute this supposed invisibility of the giraffe to its varied and mottled coat. They contrast this "leaf and shadow pattern" with the elephant's dark monochrome, which they admit not to be concealing—indeed it would puzzle even them to imagine any purpose which would be served by having elephants concealingly colored prior to the advent of rifles. They quote Samuel Baker as testifying to the concealing effect of the giraffe's coloration. But in his "Eight Years in Ceylon" Baker says exactly the same thing about the elephant! All that he really meant was that in the light and heavy jungles of India and Africa he had often found even elephants and giraffes difficult to make out, just as buffaloes and rhinoceroses in thick jungle are difficult to make out, just as the beautifully colored and striped bongo and dark monocolored forest hog are equally difficult to see.

It seems impossible to avoid the conclusion that in these cases the different patterns of coloration have nothing to do with concealing their wearers; the fact is simply that the cover, the character of the landscape, the light, are such that any animal is hard to see; and the coloration pattern is of no effect one way or the other. Too much light, like too little light, tends to make all coloration patterns look alike, and, therefore, to deprive each one of any special value. The giraffe spends most of its daylight hours in bright sunlight, as does the zebra, for both live in dry, hot climates. The glare of light in Africa and India is such that all patterns of any intricacy or minuteness tend to disappear under it. This is shown in the case of the Indian

tiger by Mr. Kearton's interesting moving pictures of a wild tiger; as the beast comes through the jungle its stripes are very distinct, but the moment it steps into the sunlight the stripes disappear as if by magic, and the animal appears to be of a light monochrome. In Africa, in the same fashion, a cheetah at a little distance looks like a lioness in color, and a giraffe appears of a uniform neutral tint.

The stripes of the zebra disappear in like fashion. One of the amusing contradictions of the ultra concealing-colorationists is afforded by Mr. Gregory, the author of "The Great Rift Valley," who considered zebras to be concealingly colored because (at a distance) he could *not* see their stripes; whereas later it became the fashion for the average writer of the school to insist that they were concealingly colored because he *could* see their stripes. The two best observers among African hunters of wide experience, Selous and Stigand, dwell especially on the great conspicuousness of the giraffe and zebra. As we ourselves have observed, the zebra often shows either white or black at a distance, according to the position of the sun. The general tint of the ordinary giraffe at a distance did not seem to us advertising; but where the pattern could be seen at all it had a slight advertising value, and the color of the reticulated giraffe was always advertising. But the size and shape of the giraffe are such that, where it can be made out at all in the landscape, it can be made out at too great a distance for the pattern to be seen.

Mr. Thayer's book is a valuable contribution so long as attention is strictly confined to what it says of colors in nature from the artist's view-point. His elaboration of the importance of countershading in concealing objects under

certain circumstances is very valuable indeed as a contribution to coloristic law. But his application of it as being the prime and well-nigh all-important factor in concealing coloration, produced through the "omnipotence" of natural selection, is wholly untenable. Nor is there warrant for his assertion that the brilliant white bellies of so many animals are the result of natural selection working toward concealing coloration. Most, although by no means all, mammals and birds are countershaded, in the sense of being of lighter color below than above. But this is also generally true of the most plentiful of all vegetable productions, leaves, and of many fruits. There is no reason to suppose that concealment has been the reason for the development in one case more than in the other. A pure white belly cannot aid in concealing an animal when that belly is itself concealed. There are snakes with white or yellow or light-colored bellies; but as these bellies are themselves concealed they have no effect in concealing the wearer, and cannot have been developed by selection or otherwise for such a purpose. The same is true of the myriads of shrews and meadow mice with legs so short that the bodies, or at least the hairs on the bodies, practically touch the ground at all times when the animal is at rest. In these cases the light belly can have no effect whatever in concealing the animal; yet when the sides are lighter than the back the belly is almost always lighter than the sides. If concealing coloration was the object, and natural selection the agent, the belly, which is not seen and the coloration of which is of no concealing service, would not have been lighter than the sides. When in motion a chipmunk or rabbit is visible anyhow, and the glimpses occasionally obtained of the color-

ation of the belly in the cases where it is white are of no consequence; when stationary the chipmunk or rabbit conceals the white, and therefore the white cannot conceal the animal. Evidently in these very numerous cases the white color has been developed by some force wholly diverse from selection working for concealment.

As this is true of multitudes of species, there seems scant reason to assume that in other species the same type of coloration *is* assumed through selection working for concealment. Nor is this all. If countershading were produced by selection working for concealment, it would manifest itself at that time in the animal's life when it would be of use; and when animals fail to possess it they would be at a disadvantage. Neither supposition is true. In the case of beasts of prey, the prime use of countershading would be when they are crouched for the final rush, or crouched as they lie in wait or slink stealthily forward toward their prey. But, as a matter of fact, the countershading largely or entirely disappears when the animal crouches; the lion, leopard, tiger, or puma when crouched loses all or almost all of the effect of the countershading. This is just as true of the beasts that are preyed on. Deer, hares, mice, all squat when they wish to escape observation; and all or almost all of the countershading disappears as soon as the animal crouches flat to the ground. Concealment, and cryptic coloration as a help to concealment, are of most value to young animals; the young are far more apt to try to escape observation than are adults; they trust for safety to hiding and remaining motionless, and they always crouch flat, usually with head and neck extended, in such circumstances. In other words, the countershading loses practi-

cally all value at the very moment when in theory it ought to be of most use.

Moreover, the so-called "countershading" in very many animals is not concealing at all, but advertising. Very light hues on the under part of a bird or mammal, even although the upper part is dark brown or black, may technically be called instances of countershading, but they certainly have not the slightest concealing value. A black squirrel is well-nigh as conspicuously colored as possible; but when he has an orange belly or even a mere white belly the addition of another vivid color does not tend to conceal him. We here speak of our personal experiences in the woods of the Southern States, where the black and orange bellied or white bellied fox-squirrels are always conspicuous in their native haunts; and of our personal experience on Buckskin Mountain, Arizona, where the big black squirrel with a white tail is of diurnal habits and is always conspicuous—its coloration being of a highly advertising value. There are very exceptional circumstances under which the white belly of a white-tail deer or a white-footed mouse or a weasel may be concealing; but they are so exceptional that they can be disregarded; ordinarily, when it can be seen at all (which on the weasel is almost never, and as regards the mice very rarely) it has a slight advertising value. When one can see the white of an impalla or sable it is usually advertising. Herons with white bellies are no more concealed than those of solid colors.

Finally, there are many animals with no countershading, living under conditions precisely like those surrounding the countershaded kinds; and yet no effect one way or the other is produced by this difference. The weasel family, a

family of finished carnivores, is rich in examples of this. The mink is not countershaded, the weasel has white underparts, the black-footed ferret, thanks to its dark legs, seems inversely countershaded; but the different color patterns seem in no way to affect their success in life. The mink is under natural conditions abundant and wide-spread; it forages on land as successfully as the weasel. Natural selection has never produced countershading in its coat. The wolverene is inversely countershaded. The fisher and sable are not countershaded. All these wide-spread, and under natural conditions abundant, carnivores are not countershaded and are not concealingly colored; ferocity, hardihood, keen senses, and (except in the wolverene) agility and power to take advantage of cover are all so developed that the quality of the coloration is evidently negligible as affecting either their prey or the not very numerous animals that prey on them.

In the deer family there are many of the, under natural conditions, wide-spread and abundant forms, such as the moose, wapiti, and sambur, which are not countershaded or are inversely countershaded; the moose is so black that it is always conspicuous; the others are no more conspicuous, except for their size, than their countershaded or spotted neighbors. The wapiti will crouch and hide, as we have personally seen, precisely like black-tail and white-tail deer or like rabbits. The wapiti calf is slightly countershaded and spotted. It therefore appears that the non-countershaded, solid-colored wapiti has been evolved from a spotted, countershaded form; and yet the wapiti still seeks safety in concealment. This means either that "natural selection" has eliminated the spots and

countershading as non-concealing (although wapiti still dwell much in the forest, so that there has been apparently no change in the character of the surroundings), or, far more probably, that the coloration is of no survival consequence. The sambur, according to Doctor Hornaday, is very difficult to see in its own haunts. Evidently these solid-colored, non-countershaded creatures are just as concealingly colored as their countershaded or spotted and varied kinfolk. The coloration is evidently of no consequence so far as their foes are concerned; habit and cover are the vital factor in avoiding their enemies.

The ordinary red fox, so widely distributed in the Holarctic realm, offers a case where several forms, one countershaded, another solid-colored, another inversely countershaded, all exist in the same species. The black fox is rare; but the specimens are as fat and in as good condition as those of other colors, showing that they are as successful in life. The cross-fox is in places the dominant form, the development of an inverse countershading having had no detrimental effect on its welfare. The red fox is in all its forms very conspicuous, its coloration being revealing and not concealing. In none of the forms of this species has natural selection had any effect in securing a concealing coloration for the highly predatory, much persecuted, and very successful animal.

Fully as significant is the case of the topi. This animal is really inversely countershaded, the color being somewhat lightest on the back, while the shoulders and thighs are very dark. This inverse countershading makes its coloration more conspicuous than that of its cousin the hartebeest. The third member of the group, the wilde-

beest, however, although countershaded, as is the hartebeest, is so much darker than the topi that it is more conspicuous. The three animals have substantially the same habits. They never try to hide; they are always in the open; when they approach a pool they are always in motion. The countershading of one and the inverse countershading of another make not the slightest difference; neither does the lesser or greater degree of conspicuousness. Their habits are such, and the habits of their foes are such, that the particular quality of their coloration has no effect whatever of survival value.

All these instances tend to show that the non-countershaded beasts are in no way hurt by the absence of countershading. In the great majority of cases countershading is certainly not a factor of survival value. It is of service only (if at all) when the difference in tint above from below is small, and the general color in strict harmony with the surroundings. If the color is not thus in harmony, the countershading has no effect whatever. A wildebeest is countershaded, a bear is not; but each can be seen, if on an open plain, a mile or two off, because the dark color is so conspicuous that the question of countershading is of no consequence one way or another. Innumerable familiar birds—grackles, cow-buntings, red-winged blackbirds, crows, red-headed woodpeckers, etc.—bear witness to the same fact.

Rabbits when motionless are either crouched flat, or else with the fore parts raised, but always with the hind parts pressed against the ground. Seen from the side, there is a slight, a very slight, countershading effect, at this, the only time when the rabbit's coloration conceals it at all;

but from behind there is no countershading effect whatever, the part of the back which is pressed against the ground being as dark as the rest. If natural selection had developed countershading as of survival value on the rabbit's fore quarters, where it can be of use only when the rabbit sits partially raised on its forelegs, it would certainly have developed it for the back and hind quarters, where it would be of use both when the rabbit crouches flat and when it sits with its fore quarters raised. But, as a matter of fact, the countershading probably has no effect—certainly no appreciable or survival effect—in concealing the rabbit, which is just as difficult to make out when seen from the rear as when seen from the side. Rabbits, like mice, gophers, and the immense majority of small mammals are hard to make out merely because their general tint is inconspicuous, wholly without regard to the countershading or the details of the pattern, so that the animal escapes detection because it is colored so that it does not strike the eye, and sits motionless like a clod or stump, amid such surroundings that the eye overlooks it because of the great abundance of the inanimate objects round about. Cover and immobility primarily, and secondarily a dull color, without regard to minute pattern or countershading, are the factors in the animal's concealment. On a perfectly bare, flat, unbroken plain a rabbit or a gopher is seen at once, at a long distance; even a mouse is visible under such conditions, and, therefore, meadow mice are most reluctant to venture beyond the protection of the grass, under the cover of which they pass their lives.

The zebra has an unholy fascination for the entire school of ultra selectionists, ultra concealing-colorationists—prob-

ably because it presents a problem the solution of which needs such infinite (and perverse) ingenuity on their part. Recently, a gentleman who observed a zebra in a zoo standing motionless after nightfall has pointed out that it gradually became invisible as the light faded. Of course it did. From actual observation in the field we can testify that on the average an eland or a roan becomes invisible a little sooner as the light fades; and unquestionably this would be true of the unstriped wild ass as compared with the striped zebra. Selous has commented on the same fact in comparing the coloration effects of zebra and oryx (or eland) at night in their native haunts. All these animals are countershaded. The topi, however, is not countershaded. It becomes visible farther off than any of them, and remains visible longer as the light grows dull. The wildebeests and sables and the adult male white-withered lechwis and white-eared kobs, because of their dark hues, and in spite of being countershaded, are in their turn a little more conspicuous than the topi under such circumstances. The natural foes of all these animals hunt chiefly by scent, although their great foe, the lion, has very keen sight; and their habits, so far as escaping from their foes is concerned, are substantially the same under like conditions, neither the countershading nor the absence of countershading, neither the conspicuousness nor inconspicuousness of the coloration, seeming to have any effect in revealing or concealing them or enabling them to escape from their foes.

As regards big game, which, when adult, have nothing to fear from birds, and whose mammalian foes are no taller than, or not so tall as, themselves, the beast of prey looks on his quarry from about the same level or from a lower

level; that is, from practically the level of the hunter, who in a stalk is usually crouching or creeping, so that he sees the game with level glance at a distance, and looking up when near by. But the immense majority of small mammals and small birds are far more often seen by their foes from above than from below; and from above the effect of the countershading is at a minimum and is usually nil. Mr. Thayer, when he observes birds or squirrels, naturally, like other observers, looks up more often than down; and unconsciously he ascribes to beasts and birds of prey this up-looker attitude. But most birds of prey have habitually the down-looker attitude toward both the birds and mammals on which they prey, and most beasts of prey have the down-looker attitude as regards the majority of the mammals on which they prey. Mice and shrews make up the immense majority of mammals, considered as individuals, not as species. Almost all their foes look down on these small mammals from above. Hawks, owls, shrikes, crows, foxes, bears, skunks, coyotes, cannot look up at mice. They look down on them. Weasels follow them purely by scent; and when they do see them it is always from above or on a level, and usually from a little above. Rabbits are looked down at, not up at, by eagles, big owls, big hawks, wolves, cougars, and lynxes; foxes generally look at them from a level or from above; weasels look up at them, but, as a matter of fact, practically always hunt them by scent. Comparatively few species of birds, when adult, have mammals or reptiles as their chief foes. The great majority of adult birds have to fear primarily other birds —eagles, hawks, and owls. These birds of prey usually approach them from above, frequently from one side,

almost never from below. This is true of thrushes, warblers, sparrows, snipe, and ducks. Now, birds in tree tops, notably in a giant tropical forest, but also even in our own woods, are so difficult for us to see as we stand (usually with the light in our eyes) on the ground, even when brilliantly colored, that hasty observers are apt to think that these brilliant colors have some concealing value. There is no warrant whatever for such belief. The foes of these birds are up among them or above them; and from above or one side these birds at once become visible; although in the flood of light and color, and in the immense confusion of vistas and obstacles, among the tree tops, they are all, whether plainly or brightly colored, infinitely more difficult to make out than when in the dark uniform monotony of the landscape underneath the trees. Let any man look out from the second story of a Virginia house in the woods at the summer redbirds in the trees on a level with the window, or in similar fashion at the Baltimore orioles in the elm from the third story of a Long Island house—we are speaking from actual experience—and contrast the ease of seeing these brilliant birds from above or from a level with the difficulty of making them out when staring up at them in the tree tops with the light in one's eyes. But even from above or from a level they are far more difficult to make out in the tree tops than they are on the rare occasions when they come to the ground; a Baltimore oriole on the lawn, and still more a scarlet tanager on a low bush in the woods, glows like a live coal. As a rule, birds which live on or near the ground in forests are sombrely colored; they are hard to see because they are not brightly colored; countershading ordinarily plays no part in their conceal-

ment; a wood-thrush or hermit-thrush is more difficult to see (as is the case with a meadow-lark in the open) when it sits with the nearly uniform dulness of its back toward the observer—although there is then no effect of countershading—than when it sits sideways, when there is an effect of countershading but when this effect is more than offset by the brightness of the white under-parts. As regards these birds it is possible that natural selection has played a certain part, not in producing a given pattern, but by eliminating the birds that were brilliantly or advertisingly colored.

In the infinitely varied and brilliantly lighted landscape of the tree tops, the coloration of the bird becomes so much less important that selection ceases to *eliminate* the brilliant hues. That selection does not in these circumstances *produce* the brilliant hues, as Mr. Thayer fancies, is evident from the fact that many of the birds, especially the females, which most need protection, remain dull-colored; the females of the scarlet tanager and redbird are no more conspicuous than the thrushes which dwell in the comparatively sombre region beneath them. Of course, if the brilliant hues of the males were developed by natural selection for concealing purposes, the females would also have developed them. The fact simply is that the brilliant colors have been developed in spite of their advertising quality.

What happens is analogous to what Mr. Reighard has described in his "Experimental Study of Warning Coloration in Coral Reef Fishes"; he shows that certain fishes, whose habits and habitat render concealing coloration of no consequence to them, develop brilliant, highly advertis-

ing coloration patterns, unhampered by selection, in consequence of some tendency or internal force having no reference to utility. Immense groups of birds, African bee-eaters and sunbirds, for instance, American humming-birds, almost all kingfishers everywhere, gulls (in the adult form), pelicans, most herons, darters, and cormorants (of all ages and sizes), most adult male ducks, all swans, the whole crow family, the whole grackle family, and multitudes of others, have developed a highly advertising coloration with no seeming relation to utility; and neither in these birds nor in the great majority of the ordinary dull-colored birds does countershading play any part in concealing them. The effort to explain all or almost all patterns of coloration in birds by natural selection working either for concealing or directive markings represents nothing but the darkening of wisdom; it serves merely to bemuddle an already sufficiently difficult problem. What is needed is the kind of study advocated in, and instanced by, Witmer Stone's "Phylogenetic Value of Color Characters in Birds."

Among mammals, squirrels are very apt to have an advertising coloration. Countershading practically never helps them. Among mice and shrews the species in which countershading can have any survival effect in concealing them are very, very few—and probably there are none.

In sum, it appears certain that although the discovery of the effect of countershading has a very important artistic bearing, it is of practically no value as affecting the question of concealing coloration in the higher vertebrates, the mammals, and birds. Among mammals it can by no possibility be of consequence save in a very few cases, and it is by no means certain that it is of consequence in these. Among

birds it may affect a slightly larger proportion of species, but the number remains but an insignificant fraction of the whole. In the great majority of species both of birds and of mammals countershading is certainly not a factor of survival value, such as could in any way affect or be affected by natural selection. Even in the comparatively few remaining cases, where it is possible that it has a small effect of solid value in concealing the species, it is very doubtful if it has been produced by natural selection, or in any other way, because of its concealing value; it seems far more probable that it is produced by some such cause as that which makes the under side of most leaves lighter than the upper, and that its trivial influence in increasing the concealing value of the coloration in these few species represents nothing but an accident.

One reason why the study of the coloration of big game is of prime scientific importance is that it enables us to visualize to ourselves something of the effect which the coloration of small animals has on their prey or their enemies. Nobody in his senses regards a cock ostrich as concealingly colored; yet it is exactly as concealingly colored as a cock bobolink, or tanager, or magpie, or lark-bunting, or yellow-headed blackbird, or red-winged blackbird, or cow-bunting, or purple grackle, or oyster-catcher, or black and white spur-winged plover, or European blackbird, or black and white chat. An ostrich looms to our eyes precisely as a coot does to the eyes of a mink or a prairie-hen to the eyes of a black-throated ferret; an ordinary antelope appears to the eyes of a hunter from the same angle that a deer appears to a cougar, or a zebra or buffalo to a lion.

Another thing always to keep in mind is that in nature

very, very few animals are seen in simple surroundings. The ordinary man thinks of a zebra or a tanager or a tiger or a bird of paradise as he sees it in a museum or as he sees its picture in a book, when it jumps to the eye; and when in nature it does not jump to the eye he immediately ascribes the concealment to the animal instead of to the landscape. There are in nature landscapes so flat and uniform that every living thing on them is thrown into relief; and others, not quite so uniform, but where anything conspicuous is easily seen. All the mammals and birds in the first type of landscape, and most of those in the second, are readily seen. Antelope on the bare, flat plains, and smaller animals on these plains if the grass is very short, sea-birds on or over the ocean, orioles and blackbirds and robins on lawns, loons and ducks on lakes or wide rivers, cormorants, auks, puffins, guillemots on cliffs and rocky islands, herons and pelicans and ibis along beaches and bare shores—all show as distinctly as they would under like conditions of light and distance in a museum. If in these places any birds are concealed as young gulls and stilts or some grouse and night-hawks are concealed, the concealment is due to coloration and not to the landscape.

But most landscapes are not of this simple character. Animals of all colors and patterns that live in grass below the level of the tops, or in forests, or even in bare country which is much broken and accidented, become extremely difficult to see. The inexperienced or unthinking man has no idea of the extreme complexity of the average landscape. The myriad of varying lights and shadows, the countless gradations of color, the innumerable twigs and leaves, the hummocks and irregularities and infinitely varied details

of the accidented landscape, the multitude of varying vistas, interlaced and superimposed, and of every length and size, make it well-nigh impossible for the eye of man or of beast or bird of prey to pick out anything motionless. Unless of strikingly conspicuous coloration, any animal that is motionless escapes notice. Hawk and owl and hunting man are all alike—ever on the watch for movement; and this is also true of the things that are hunted. This is why any animal that "freezes" (as that keen observer, Mr. Seton, calls it), from an elephant, or rhino, or buffalo to a grouse or meadow-mouse or vireo, is so hard to make out. The immobility and the cover and surroundings count for infinitely more than the coloration. A first-class naturalist and observer, Mr. Pyecraft, in his "Infancy of Animals," speaks of the pattern of cover-haunting animals as "forming a more or less perfect obliterative coloration, causing the solid body to vanish, as it were, into thin air." In reality it is the landscape, and not the coloration, which thus obliterates the animal. The spotted, the striped, and the unicolored animals are all obliterated in precisely the same manner. The landscape, not the coloration, is the obliterator in the great majority of cases. All that is demanded of the coloration in *these* cases is that it shall not be of such a highly advertising type as, say, black or white —and nature does not always insist even on this modest requirement.

The ultra natural-selection and concealing-coloration extremists, who treat *concealing* coloration as being of primary importance to the welfare of the great majority of mammals, including the big mammals, and as being almost universally present, should carefully study the big bovines,

cervines, and other grass-eaters, and the big felines, canines, and other flesh-eaters, in their native haunts. As regards big mammals the theory is certainly untenable. Not only are most big mammals not concealingly colored, but in most of the cases where the concealing coloration exists it confers no advantage on the possessor, because of the overwhelmingly superior importance of such matters as bodily power and habit.

Probably the most effectual concealing-coloration patterns among big mammals, under the average conditions of actual environment, and at the crises of their lives, when they prey or are preyed on, are the countershaded khaki or tawny brown of the lion and cougar and the countershaded gray of the ass, wild or tame. The lion and cougar we have studied with care when wild; we have never seen the wild ass; but the tame ass and feral ass, colored in substantially the same manner, we observed under natural conditions on the Western plains. Among the horses, cattle, and asses out on the range, observed under all weather conditions at all seasons, and by day and night, the gray countershaded donkeys were on the average the most difficult to see. Next came the dun or claybank horses, which were not countershaded; usually such a horse was at night almost or quite as inconspicuous as a donkey, except for the size. Then came the bay, brown, and red horses and cattle; and finally the black and white, which, under almost all circumstances, by day and by night, were the most conspicuous. At certain times at night the donkeys were practically invisible, even when very close, until they moved.

In Africa, of the big game of the plains and the thin forest or scrub which we observed, the eland, big gazelle,

roan, and oryx, in that order, most resembled in their body patterns the coloration of the wild ass, and were, on the whole, the most difficult of the big game to see when feeding or resting. The face markings of the oryx and roan and the long horns of the oryx possessed some advertising value; and both eland and oryx, when not too distant, were advertised by the continual switching of their long, black-tipped tails; again and again, if the animals were among bushes or trees, it was this continual tail-switching which first betrayed their presence. Doubtless the same thing is true of the roan, but we happened not to observe it. When at a distance such that the various black and white markings and the horns were invisible or indistinct, the general body color of all three animals harmonized well with the ordinarily almost leafless or brown-leafed scrub and dry grass; if in company with hartebeest, wildebeest, or zebra, any of these three animals were almost always seen before the eland, oryx, or roan. In the flood of bright sunlight which was usual the wildebeest was most conspicuous, near or far; at night it was, on the average, most conspicuous, although on moonlight nights the zebra sometimes seemed white, and was then the most conspicuous animal of all. The topi, perhaps because of its inversely countershaded coloration, came next to the wildebeest in conspicuousness under average conditions, while of the hartebeest and zebra one was the more conspicuous under certain conditions of light and shade, and the other when the conditions were reversed, the coloration of both being normally, and at the most important crises of the animals' lives, advertising and not concealing. The bull sable, buck white-eared kob, and buck white-withered lechwi possessed

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coloration patterns of a strikingly advertising quality. The stripes of the eland had no effect, one way or the other, in advertising or concealing it, when compared with the unstriped roan. The black lateral and leg markings of the oryx were advertising, as was the case with the black lateral lines on the Tommy gazelles and on the female and young Grant gazelles. The male Grant gazelle was as concealingly colored as the roan and eland and, because of its smaller size, less conspicuous. The dark-gray waterbuck and reddish impalla were more conspicuous when away from cover, and when thus away from cover never sought safety in trying to escape observation; nor did the reddish kobs. But these animals often sought the concealment of cover, unlike the regular game of the open plains. The waterbuck, eland, roan, oryx, and big gazelle seemed a trifle the least conspicuous on moonless nights; if the nights were dark all the animals were practically invisible, and yet these seemed to be the nights when the lion was boldest and most successful. The wildebeest, topi, and hartebeest are advertisingly colored compared to the eland, oryx, and roan of the same habitat. We saw the former more readily and at a greater distance than the latter, but careful study on the ground failed to show that this was of any disadvantage to the former or produced any change in habits.

The big game of the plains live substantially similar lives, and trust exclusively to their senses, their watchfulness, and their ability to run away. Coloration plays no part in shielding them from their foes; nor do they seek to take advantage of cover; habit is everything. The lion's eyesight is so good that probably none of these animals ever

escape his notice unless at a distance that renders it immaterial whether he sees them or not; he trusts mostly to his sense of smell; he ordinarily hunts at night, and is most successful on dark nights, when the coloration is of little consequence; and when near enough to be dangerous, whether by day or night, he sees so clearly that the color of the quarry is a negligible factor—an eland or a roan is evidently seen as clearly as a sable, a wildebeest, or a zebra. Hartebeests in the aggregate far outnumber oryxes, yet relatively to oryxes they are conspicuous, and their habits are identical so far as escape from their foes is concerned. Evidently the advertising color of the hartebeest's coat has not been of the slightest disadvantage to him in the struggle for life. As is the case with all other plains game, his habits are such that his coloration is from this standpoint of no consequence. The hartebeests in a state of nature are probably the most successful and widely distributed of all African animals of their size, yet they are not concealingly colored and carry no recognition marks.

The ostrich offers a very instructive case in point. The black and white cock ostrich is, except the elephant, and possibly the giraffe and rhino, the most conspicuous creature of the plains. The soberly colored hen cannot be seen at all at a distance when the cock is already plainly visible. She may fairly be said to be concealingly colored. He is a striking example of advertising coloration. But both have precisely the same habits. Save when brooding—and both brood alternately—the great birds never seek to escape observation, never do escape observation, and trust for safety solely to their wariness, their eyesight, and their speed. The nest is placed on the bare sand, usually with

bushes round about, and, when on it, both birds lie flat, with outstretched neck, if they suspect danger. It is said that the hen broods by day and the cock by night, but twice we came on cocks brooding by day. Moreover, by moonlight the cock's coloration is almost as conspicuous as by day; and on all nights, if the birds can be seen at all, the cock is most conspicuous. At all times, therefore, including the most vital moments and crises of their lives, the cock's coloration is boldly advertising and that of the hen somewhat concealing. Yet the habits of the two are identical. Both have the same foes, the lion and very occasionally the leopard, while the young are in danger from hyenas, jackals, eagles, and big hawks. The birds are monogamous, so that the numbers of the sexes are substantially equal; which means that the highly advertising coloration of the cock is of no disadvantage to him in the struggle for existence. Evidently his coloration has not been developed by natural selection or because of any utilitarian purpose, and, equally evidently, the relatively concealing coloration of the hen has no survival value as compared with the cock's coloration.

The same statement applies to various antelope. The female and young Grant gazelle and the Tommies of all sexes and ages have a lateral black band which is distinctly advertising. The adult male and occasionally the old female Grant gazelle lack the stripe, and their coloration becomes concealing. Yet there is absolutely no difference in habits, and no benefit or detriment is caused by either the presence or the absence of the black lateral band. The adult males of the sable, white-withered lechwi and white-eared kob are advertisingly colored compared with the females;

but this has not made any difference in their habits, and the advertising coloration of one sex and concealing coloration of the other apparently confer neither any advantage nor any disadvantage in the struggle for life. Habit and cover are the vital factors. The old bucks of the white-withered lechwis are inversely countershaded, being white on top (like one species of serow). We are often asked by the concealing-colorationists to consider how the coloration of the tiger would reveal it if it were inverted; well, in these antelopes the coloration *is* inverted! and no detrimental results follow, although they, also, are cover-hunting species. This fact alone is sufficient to cast grave doubt on the assertion that the tiger's stripes and countershading and white belly have been developed by natural selection for concealing purposes; probably they have no survival value. The sitatunga dwells in reeds on water-soaked ground like the lechwi; their colorations are so totally different that they cannot both be concealing. As a matter of fact, it is probable that neither is; but that of the adult buck lechwi is certainly revealing.

In the deep, moist forests the true big-game animals are the beautifully striped and richly tinted bongo and the dark monochrome forest hog. Both have the same foes and the same habits so far as their relations to these foes are concerned. The colorations are utterly unlike, and if one is concealing the other must be revealing. As a matter of fact, neither has any effect in either concealing or revealing the wearer; habit and cover are all-important.

The bushbuck extends over vast areas of Africa, and its various forms exhibit the widest variety of coloring. In some regions the coat is a network of white stripes and

spots (the patterns, however, being very different in different forms); elsewhere these are reduced in the old males almost to the point of total disappearance. Their foes are everywhere the same. Their conditions of life vary as much concerning certain of the harnessed forms—the form we found in the dry, open, thin forest of the Lado, for instance, compared with the form found in the dense wet jungle of Uganda—as they do between the harnessed forms and the nearly solid-colored forms. Solid-colored duikers are found in the haunts of both the solid-colored and the patterned bushbucks. Under these circumstances it is impossible to regard the pattern or lack of pattern as having any survival value in concealing the animal from its foes; some factor other than natural selection working toward a concealing coloration has been at work in securing the retention of the pattern in some forms and its reduction or elimination in others. The great explorer and naturalist Dr. Schweinfurth regarded the harnessed bushbuck as conspicuous *because* of its striped and spotted coat. I am inclined to agree with him; but in any event it is quite impossible that one form of bushbuck is concealingly colored because it does possess, and the other because it does not possess, the stripes and spots.

Of the other bush game the reedbuck is colored much like the white-tail deer. It trusts to hiding for concealment. So does the oribi, where the grass is long; but where the grass is short its habits are like those of the gazelles. The duiker is, of all these antelope, the one that can most properly be called concealingly colored; and we are inclined to think that its dull gray, slightly countershaded coat does have a concealing value. But we are not certain, for

its stealthy, skulking ways, and its habit of clinging to and taking advantage of cover, are such that it would be difficult to detect anyhow. The same observations apply to the dikdiks. The Chanler reedbuck behaves much like the klipspringer; its coloration is more revealing.

The steinbok offers an interesting problem when compared with other buck of the same size but different habits, such as the klipspringer and Tommy gazelle. The klipspringer lives among rocks; its coloration tends to harmonize with its surroundings; and with the possible exception of the duiker it is the only one of all the African antelopes in which it seems as if the countershading may add to the concealing quality of the coloration. But, compared with the steinbok, the klipspringer does not hide at all; it is a noisy little buck, continually uttering a shrill whistle of alarm or curiosity; it trusts for safety to its vigilance and its ability as a rock-climber. The Tommy never tries to hide. It lives on the bare, open flats, and trusts to its vigilance and speed for protection. The steinbok, on the other hand, which lives on the grassy flats and among bushes, both on the plains and along the hillsides, is a skulker and hider; yet its coloration is not concealing. Its bright-red coat was advertising under all the conditions under which we observed it; nor did we anywhere see a normal background with which its coloration would have harmonized. Nevertheless, it trusted almost exclusively to concealment for safety. Nor did it merely use as a screen thick cover so impenetrable that through it no coloration could be made out. It continually endeavored to hide in very scanty cover; we often found it practically concealed in tufts of rank grass or behind or alongside of some small

bush. As soon as it saw a man at a distance its tendency was to lie down; it treated the recumbent posture as its natural position when threatened; whereas the Tommy always felt that it was at a disadvantage when lying down, was uneasy, and immediately sprang to its feet when it saw what it regarded as a possible, but distant, menace. The steinbok lay down when its foe was at a distance in hopes to escape observation, but kept its head raised watchfully. If the foe came nearer and it still hoped to escape notice it laid its outstretched neck and head on the ground, and sprang up only when it deemed it hopeless to expect its enemy to pass it unseeing. When it ran it would often stop behind a bush, after going a few hundred yards, and lie down again; and then it might be readily stalked. If under or beside a bush, the shade, or, if the foliage was thin, the checkered play of sunlight and shadow, made it easy for it to escape the eye unless we knew just where to look for it; but so far as, and whenever, its coloration had any effect it was an advertising effect. I am somewhat puzzled how to account for these facts in the compared cases of the steinbok and klipspringer. The latter has a much more concealing coloration than the former, but is noisy and alert, and trusts hardly at all to concealment; whereas the animal that lives under conditions that would seemingly make a concealing coloration helpful, and whose habits also would seemingly make it helpful, has no concealing coloration.

If we trusted only to such cases as this we would be inclined to agree with those ornithologists who, like Mr. Outram Bangs, doubt whether concealing coloration is correlated with the hiding instinct, and are inclined to believe that all animals, no matter what their coloration, alike tend

to try to escape observation by remaining motionless. There are, however, plenty of instances to the contrary. A good example, among closely related species, is the case of the desert chat compared with the black and white chat. Both birds are found along the edge of the Egyptian desert. The black and white chat is a boldly colored bird, with actions which correspond; it is alert, wary, active; its coloration advertises it at a long distance, and it makes no attempt to hide, dodging round rocks and through crevices, and trusting to its agility and watchfulness for safety. The desert chat is colored above much like the desert itself; when it crouches it offers an excellent example of concealing coloration (non-countershaded), and it makes use of this fact in a way that tends to show that the coloration is, in this case, a factor of survival value; for its main reliance, when danger threatens, is in crouching motionless to avoid observation. As regards the black and white chat, it is self-evident that neither natural selection nor any other tendency toward the production of a concealing coloration has been at work; evolution has brought about a highly advertising coloration of a kind which can hardly serve any purpose of utility, and habit is practically the sole factor in securing the bird's safety from its foes. (Mr. Thayer's theory that their coloration has any effect, as regards any of these insect-eating birds, in helping them secure their prey need not be taken seriously.) As regards the desert chat, the coloration *may* have been developed by natural selection for purposes of concealment; but as it is of substantially the same type as the coloration of many other desert animals which do not trust to, and are not benefited by, concealment, it seems more likely that it is due to

other forces generally, although not universally, at work as regards desert animals. If this is true, the habit of acting so as to benefit by the coloration has become ingrained, while no such habit has arisen, or has persisted, in the case of the black and white chat, where the coloration is such that no action would make it beneficial for concealing purposes. The steinbok, on the other hand—although it does not possess a concealing coloration—does not possess an extreme and striking type of advertising coloration, and in its case the habit of endeavoring to escape notice by immobility, so wide-spread among living creatures, has persisted, and, to judge by the fact that the species is common over a wide range, has been successful as a survival factor.

Among the African carnivores we came across two or three of the lesser species with a strikingly advertising coloration; the ratel, for instance, and the white-tailed mongoose, a highly predatory creature. What "warning" function this coloration can serve in these two cases it would be hard to imagine. The black back of the black-backed jackal is revealing; but the animal thrives as well as its more concealingly colored kinsfolk. Most of the smaller carnivores have colorations that if they do not conceal at least do not reveal them. The hyenas include three forms—a brown, a spotted, and a striped. Their habits, their lack of enemies, and the circumstances under which they make their rare attacks on living things make it difficult to believe that they have special need of any one of these three coloration patterns; doubtless the coloration of no one of them serves any concealing or other useful purpose to the animal at present; and it certainly seems as if the three totally distinct patterns had been developed for

some non-useful reason, without any reference to natural selection. The habits of the hunting-dog forbid the belief that its conspicuous coloration has any effect one way or the other on its success in life, or that it has any survival value such as would give a chance for the working of natural selection.

There remain the lion, the leopard, and the cheetah. On the whole, as we have said, the lion's coloration, like the cougar's, represents pretty nearly the maximum concealing power for a beast which—unlike the nearly stationary animals or those of narrowly limited habitat—necessarily roves through many and varied kinds of landscape. But there are features of the coloration which are not concealing—the lightish and black-edged patch on the rump, for instance—while the black tips of the ears and tail are often the first things to attract attention. Much more important, however, is the mane. This is always of a somewhat advertising value, and when it is black it has a strongly advertising value. Yet black-maned lions are very fine and powerful beasts, at least up to the general level of their kind, as well-fed, and as strong. The fact that a conspicuous black-maned male and an inconspicuous maneless male or female do equally well in killing game rather shakes our belief in the survival value of the lion's general concealing coloration. We are inclined, having this fact in view, seriously to doubt whether the lion's coloration is a survival factor, although it is probably, among all the colorations of all the big cats, bar only the puma, the most effective concealer. Young lions are dimly spotted and striped; probably the lion comes from a spotted and striped ancestral form. The loss of the spots is ascribed by natural-

selectionists to the fact that the lion has changed its habits and become "a dweller in the open," while the tiger (so closely kin to the lion that the species interbreed, their skeletons being almost indistinguishable) dwells "in dense jungle, where his stripes, harmonizing with the tall reed stems, make him invisible, and enable him to stalk his prey without being seen." This explanation is probably opposed to the actual facts. The tiger is very rarely found among reed stems; reed-dwellers like the lechwi are rarely striped, and, as we have already said, Kearton's photographs show that the stripes are much more conspicuous in the shadow of a jungle than in the open under the sunlight. The sambur is one of the animals on which the tiger habitually preys; the two dwell in the same dense jungles; the sambur is solidly colored, a dark unicolor without countershading, and yet Hornaday has shown that it is peculiarly hard to see, harder than the tiger. Moreover, the tigers of Mongolia and Manchuria live in surroundings wholly distinct from those of Hither and Farther India. We do not believe that the tiger's coloration, as being of any use to it in eluding the vigilance of its prey, is a factor of survival value, or has been developed by natural selection for this particular utilitarian purpose.

The cheetah is a diurnal animal, and lives far more completely in the open than the lion. Yet the cheetah has retained its spots. The spotted coat of the leopard is often advanced as "the most perfect imaginable concealer," having "the flecked leaf and sunlight pattern" best suited for a dweller in woodland. There is advantage in considering together these four big cats, the lion, tiger, leopard, and cheetah, with the two big American cats, the puma (or

cougar) and the jaguar; four of the six we have ourselves carefully studied in their native haunts. As soon as this study is seriously undertaken it will be seen that it is infinitely harder to draw sound conclusions than the extreme partisans of selection and concealing coloration admit. In the first place, as to the loss of spots by the lion and puma, alleged to be because of their taking to a life in the open: The cheetah lives more in the open than either, and is more diurnal in its habits, yet it has retained its spots. At a short distance in the African sunlight these spots disappear; probably in view of the habits of the cheetah it would be of no slightest consequence to it if the coloration of the lion, leopard, or tiger were substituted for the coloration it actually possesses.

Moreover, the spotted cats, the leopard and jaguar, and the unicolored cats, the lion and puma, have for ages possessed overlapping ranges, in which both types of coloration have persisted side by side practically unchanged and with seemingly equal benefit to the wearers. The New-World and Old-World couples, each of one spotted and one unicolored cat, reverse conditions of distribution. In the Old World the spotted leopard is far more widely distributed than the unicolored lion and occupies most of the lion's range and habitat. In the New World, on the contrary, the unicolored cat, the puma, occupies a far wider range, which includes most of the jaguar's range and habitat. In most of the open country in which the lion is found, from Somaliland and the Lado and East Africa to the regions south of the Zambesi, the leopard is also found; and everywhere within this vast range they are most often found in the same cover of thorn-trees, bushes, reeds, and grass; al-

though the leopard also penetrates the deep forests in which the lion does not dwell. In the reeds, the very cover supposed to be peculiarly fitted to the tiger's coloration, both lion and leopard are practically invisible; for in such cover it is the physical screen of the cover and the habits of the big cats that are practically the sole causes of their invisibility. The lion's coat is supposed to have been developed to suit the open country; but a leopard in the grass, under the flood of bright light, is at least as difficult to see as a small lioness and more difficult to see than a black-maned lion. This we can testify from our own observations in the field. In the sun-flecked or uniformly dark shade of the bush or tree cover there was again no difference perceptible in the average visibility of the coloration; if anything, the leopard's coat was just a trifle less concealing. But the difference, one way or the other, was wholly unimportant. The leopard was smaller than the lion, was even more cautious and wary, and was an even greater adept in stealthy, sinuous crawling and hiding; and therefore it was, on the whole, harder to see, whether in grass-land or bush.

The contrast between the two big cats and the game on which they preyed, under like conditions, showed the utter unimportance of color compared to habit. There were in places enormous stretches of flat country covered with grass a couple of feet tall more or less, either entirely treeless or very thinly studded with occasional thorn-trees. Every zebra, eland, wildebeest, hartebeest, topi, roan, oryx, kob, waterbuck, or big gazelle, and, of course, every giraffe and rhinoceros, in such a stretch, was visible; the animal made no attempt to avoid observation and no attempt to crouch and hide when it discerned danger. But if, as often hap-

pened, there were lions and leopards in such a tract, it was difficult to see or find the former, and far more difficult to see or find the latter, because both species were always slouching and crawling, or lying down in some thicket or tall bunch of grass; and either one of them when it first saw danger, if it thought itself unobserved, promptly crouched and lay motionless or else slunk rapidly and stealthily off below the level of the grass tops. Neither the lion's nor the leopard's coloration was in any degree more concealing than the coloration of some or most of the grass-eaters; if the big cats had been mounted on higher legs and had possessed the habits of the grass-eaters, their coats would have shown no more concealing quality than the coats of the hartebeest, eland, and oryx. Habit, and especially the ability to take advantage of cover, were the vital factors, the survival factors, in securing concealment; the exact shade or pattern of the coat was a wholly negligible factor.

The case of the puma is very instructive in this regard. It is as plentiful as the jaguar in the great tropical forests, and is found in many great temperate forests which the jaguar never reaches. Mr. Thayer gives an ingenious picture to show how the jaguar's spotted hide absolutely conceals him among the foliage (not natural foliage, but foliage put in by Mr. Thayer to prove his *point*), and points out that if it were unicolored the animal would be revealed; he forgets that the puma, equally common in exactly the same surroundings, is unicolored and is not revealed. Now, our experience, in accord with the experience of most hunters and out-of-door naturalists, is that the cougar is, of all American big animals, the most difficult to see and the most rarely seen. Its neutral-tinted, nearly unicolored,

slightly countershaded coat unquestionably has a concealing quality in the woods and among clay banks and rocks under ordinary conditions, and for long we accepted this as the chief element in explaining its invisibility. But when we came to think out the matter we realized that a totally different theory must be invoked to explain the cougar's invisibility during winter in that large part of its range which at that time is snow-covered. We have spent some time in country where cougars were common, on the Little Missouri and in the Rockies. In places the land was thickly forested; in other places it was open, the bad lands, hills, and mountains being sparsely clad here and there with piñon, cedar, buckbrush, and the like. The wapiti and blacktail that lived in such places were easily found and seen—unlike what was true in the dense forests. But the cougars were invisible, and this was just as true in winter, when the landscape was white, as in summer. They could be trapped, and they were readily killed with hounds; but even the oldest and most skilful hunters hardly ever saw them on other occasions. This means that the cougar's coloration was really an insignificant and practically negligible factor in its concealment. The prime factors were its nocturnal habits, its sharp senses, its wonderful ability to take advantage of even the scantiest cover, and its power of lying indefinitely motionless and of advancing with inconceivably noiseless stealth. The cougar is found in boreal regions of heavy snowfall and in steaming tropical forests, on bare broken plains and in the Rockies and the Andes, in the great hardwood and coniferous forests of the United States and on the barren Patagonian grass-land, in thick cover and in scanty cover. Everywhere it is equally invisi-

ble. It would be as invisible in the homes of the tiger and leopard as it is in the home of the jaguar. The black leopards and jaguars really are as invisible in their homes as are their spotted kinsfolk. The conclusion seems inevitable that no one of the coloration patterns, that of lion, tiger, cougar, cheetah, leopard, or jaguar, has any survival value as a factor in the life-history of the animal; it cannot have been produced by natural selection working for concealing coloration. We believe that the same conclusion applies to the ounce, lynx, ocelot, clouded tiger, jaguarondi, eyra, wildcat, and all the other spotted, mottled, and unicolored cats, big and little. It is greatly to be wished that some trained scientific observer and investigator would study the cat family—and for the matter of that, such distinctively colored groups as the tragelaphs and the deer—along the lines laid down by Witmer Stone in his pamphlet on the "Phylogenetic Value of Color Characters in Birds," elsewhere referred to.

The giraffe, because of its size and shape, is always recognizable at such a distance that its coloration is of no consequence; the reticulated giraffe has a bright-reddish coat of a highly advertising quality; but this does not hurt it any more than does the common giraffe's less conspicuous—but, when close, conspicuous—coat. The coloration is a negligible factor. If among trees, in the flood of the African sunlight, the giraffe may escape the notice of an ordinary native or white man; but it practically never escapes the notice of the trained eyes of the native hunting tribes. Good observers have expressed their surprise at its being difficult to see. Our experience was that on the average it was seen at a longer distance than any animal

except the elephant. It never sought to hide or to escape notice. The black, monochrome buffalo was not nearly as conspicuous, in spite of its coloration, because the giraffe's size and shape rendered it visible at such a distance that the coloration was of no consequence. Even the bulky monochrome rhinoceros was usually made out at a distance less easily than the giraffe; for the giraffe rarely lies down and the rhino lies down as freely as a pig. Of course, under certain circumstances every animal, no matter of what shape, size, or color, even the elephant itself, becomes hard to see if it remains absolutely motionless. The coloration of the giraffe might, seemingly, be of benefit to the buffalo on account of the buffalo's size and habits; yet, as a matter of fact, the buffalo has a dark, highly advertising coloration —intensity of color being of far more consequence in either revealing or concealing an animal than either pattern or countershading. But the buffalo is not seemingly harmed by its coloration.

The study of American big game shows that coloration plays an unimportant part as a factor of survival value in their life-histories. The bison and peccary are neither countershaded nor concealingly colored. The color of the white goat is highly advertising, especially at the most critical period of its life, when the kid is young and is in danger from the eagle. The prongbuck, although countershaded to the extent of having a white belly, possesses a highly advertising coloration. It never hides or seeks to escape or does escape observation when adult; the very young, as with the young of all these animals, do try to hide, lying flat on the ground with outstretched neck, in which position the countershading disappears. Moose and

wapiti are not countershaded and are revealingly colored; but both seek to escape notice by immobility and stealth, and the wapiti crouches flat like a deer. The Rocky Mountain and coast blacktails are, at least in some of their forms, not countershaded; often, owing to the black hair on the chest, the fore parts of their bodies are inversely countershaded; but they crouch and skulk, and the general tint of their coloration is not revealing, and under certain conditions is concealing, although the white rump of the Rocky Mountain blacktail is always revealing. The mountain-sheep has a revealing white rump; its general coloration in the United States and Mexico is concealing rather than revealing; but the black and white sheep of the boreal mountains are advertisingly colored, and yet no difference in their habits is thereby caused; evidently no one of the coloration schemes is a factor of survival value.

The case of the white-tail deer is interesting when it is compared with the fallow deer of Europe and the axis of India. In its winter coat, unless when snow is on the ground, the coloration is not revealing—although its coloration is hardly concealing in the sense that is true of the blacktail and the southern form of the mountain-sheep. But in spring and summer the bright-reddish coat is of a very revealing quality against the bright green of its home; and this at the very time that the breeding or nursing does and velvet-horned bucks are most in need of protection. Nevertheless this advertising quality of the coloration is of no detriment, because the animal is such a finished skulker, and lives in such dense cover that in summer it need fear only foes which hunt it by scent. The flaunting flag is very conspicuous; and the white belly, although to a less degree,

is also advertising. The young fawn, however, is spotted; the spots are lost in the adult. In the fallow deer the spots persist in the adult in its summer coat; and in the axis they are permanent at all seasons.

The view taken of these phenomena by some moderate and sensible natural-selectionists and concealing-colorationists, men whose judgment is generally sound, and whose position must be treated with careful and respectful consideration, is well put by Mr. Pycraft. He says, "The fallow deer is a forest-haunting species," and during the summer months lives "where the play of the sunlight through the foliage scatters spots and shafts of golden light on every side. Thus the spotted hides of the deer blend insensibly with their surroundings." But in the fall the spots are lost and the unicolored coat then "no less perfectly harmonizes" with the dull landscape. "In the axis deer, also a forest animal, the spotted coat is worn the year round, and this because it is happy in living in regions where the sombre pall of winter is never spread." Mr. Pycraft explains that the spotted (and striped) patterns are normal for species which dwell amid the cover afforded by vegetation, where they form "a more or less perfect obliterative coloration, causing the solid body to vanish, as it were, into thin air," but "that so soon as these patterns fail to serve any useful end—their purpose is to cut up the solid appearance of the body and so destroy its contour, hence they are called secant patterns—they begin to disintegrate," while they are retained so long "as they confer benefits," their "change of form" being "determined" by "that sumptuary law which is part of the machinery of natural selection," for the pattern degenerates when "the need for a spotted

livery is past," "because natural selection no longer rewards those individuals in which the livery is best developed."

This is the best presentation of the theory of the natural-selectionists. If only the fallow deer and axis were considered, it would seem convincing. But it breaks down completely when other deer, the majority of deer, are considered; for although they still live in the cover afforded by vegetation, and are descended from spotted forms, the adults, in the large majority of the species, have lost their spots. Take the abundant and widely spread white-tailed deer of America, which, in its various forms, extends from the northern isotherm marking the northern range of the fallow deer to the tropics, between the isotherms in which the axis dwells. The fawns are spotted; doubtless the adult ancestral whitetails were spotted; the whitetails live now in just such cover as do the fallow deer and axis; and yet they have lost their spots and are solid-colored above. It seems incredible that natural selection can be responsible for both of two such diametrically opposite results; and, of course, if being spotted tends to conceal the deer, then the loss of the spots cannot have been due to natural selection making for a concealing coloration. This is self-evident. The red deer, which lives in the same country as the fallow deer, and the sambur, which lives in the same country as the axis, have also both lost their spots in the adult forms. All these deer have substantially the same foes; wolves or wild dogs, and the big cats. If a spotted coat really is concealing, then surely natural selection ought not to have eliminated it in the great majority of the deer, as it has actually done.

Mr. Pycraft further illustrates his point by the tapirs. The young tapirs of America and Malaysia are spotted and striped, while the adult Malayan tapir is boldly pied black and white; and the spotted coloration of the young and the pied coloration of the adult are both stated by Mr. Pycraft to be "of a highly protective character." But the adult American tapirs, of several species, are of a dark monochrome, which Mr. Pycraft does not claim to be protective, and which most concealing-colorationists treat as highly advertising. The adult tapirs of the present day are held to be descended from spotted and striped ancestors and, therefore, to have changed their coloration. But all the evidence indicates that they have not changed their surroundings, their habitat. They dwell in forest and jungle now, exactly as their striped and spotted ancestors did. There has been, as far as we know, no change of environment to alter the survival value of the pattern. Yet it has disappeared as completely as in the case of any plains-dweller. The argument Mr. Pycraft makes as to the reason for the disappearance of spots among the descendants of forest-dwellers which now live in the open prairies does not apply to, and, indeed, seems to be controverted by, the facts regarding those creatures which continue to dwell in forests exactly as their ancestors did; for the loss of spots seems to have gone on in one set of cases much as in the other. The cheetah lives on the plains, but has retained its spots; the tapirs and most deer and pigs live in the forests, but have lost their spots. In the case of the tapirs, the Malayan animal is said to have developed a concealing coloration by being given a livery of white, and blackish; yet the more plentiful American tapirs have developed a uniform, solid,

blackish color. The variety of habitats among the American tapirs is wider than is the difference in character of environment between one or two of the species and the Malayan tapir. All have foes of the same kind, the big cats; the tiger and leopard in Malaysia, the jaguar and puma in America. The coloration of the Malayan tapir can only be called concealing if the coloration of the American tapir is admitted to be revealing. As a matter of fact, we do not for a moment believe that the coloration of the former is really as concealing as the coloration of the latter; the observers who so read it really only mean that in their surprise at finding that almost all animals, of all colorations, are inconspicuous in forest and jungle they attribute to the animal's coat an invisibility that is really due to the landscape. The observer whom Mr. Pycraft quotes states that the Malayan tapir, when lying down in the daytime, resembles a gray bowlder bathed in sunlight, the implication being that natural selection has picked out its coloration so as to resemble bowlders in the sun. Well, in Africa we have seen rhinoceros when lying down in the sun mistaken for ant-hills; and there is no question whatever that an American tapir would, under similar circumstances, be mistaken for a darker-colored bowlder. The facts in the case of the tapirs do not prove that one coloration pattern is more effective than another as a concealer of survival value under the play of natural selection. They prove the exact reverse. The facts quoted by Mr. Pycraft, if the interpretation of the natural-selectionists were correct, would show (1) that tapirs were formerly concealingly colored; (2) that, without as far as is known change of environment, one of them has developed a totally different type of concealing

coloration, while all the others, under practically similar conditions of habitat and of enemies, have developed a revealing type of coloration. We do not believe this interpretation to be correct. What such facts really show, in our judgment, is either that there has been a steady trend away from a concealing and toward a revealing coloration, or else that, as regards these forest and jungle dwellers, habit and cover are of such overwhelming importance in the lives of the creatures that the pattern of coloration ceases to have any survival value, and is determined by some tendency, or cause, or tissue of causation, entirely distinct from the operation of natural selection to secure the survival of the fittest by shielding them from the observation of their foes. The same conclusion applies to the deer of the forest and jungle. Nineteen-twentieths of them are now solid-colored. The tendency, evidently, is to lose the spotted pattern, even where the environment is unchanged so far as conditions telling for concealment are concerned; which necessarily shows that this pattern does not possess survival value.

Thus all the facts tend to show the fundamental error of the entire body of conclusions advanced by the natural-selectionists as to the present survival value of the spotted, striped, and pied patterns of coloration among forest-dwelling animals. These are found much more frequently and much better developed among the young than among the adults; so that the tendency among the adults has evidently been away from the patterned ancestral type. Already the tendency has gone so far that the older patterned types are far outnumbered by the monochrome types among the bigger carnivores and grass-eaters in the

thick forests of the temperate and torrid zones. The jaguar is spotted; but the other big cat of the same region, the puma, and the big dogs, and all the big animals upon which they prey—the tapirs, peccaries, and deer—are practically monochrome, and many of them are not countershaded. The tiger, leopard, and axis, which are striped or spotted, are far outnumbered by the monochrome or practically monochrome lions, dholes, wolves, boars, deer, antelopes, and oxen of the same forests and jungles. There is one pied tapir; there are several monochrome tapirs. The wild oxen are practically monochrome, except for one or two species which have an advertising white rump; nine-tenths of the species are monochrome. In Africa the same tendencies are manifest. The nearly monochrome or nearly unicolored species of the forest, the jungle, and the reed beds much outnumber the species which are appreciably spotted or striped, and among these the tendency evidently is for the spots or stripes to disappear; the elands, evidently descended from a highly striped type, have in some forms almost or completely lost their stripes, and the same is true of the bushbucks. In the arctogæal forests, boreal and temperate, the elimination of the patterned types has gone much further. The conclusion seems inevitable that the patterned types in the world of to-day have no survival value, and that their coloration at present (using "present" in a geologic sense) confers no benefit upon these spotted and striped animals when compared with the monochrome or nearly unicolor animals, whether these latter are or are not countershaded.

This statement about present-day conditions does not justify us in dogmatizing about conditions in the immemorial

past. Mr. Pycraft (unlike Professor Poulton, and especially unlike Mr. Thayer) fully recognizes, and insists upon, the fact that there is no warrant for believing that these patterns are due to existing factors of selection or to the action of selective forces now at work; he explicitly states that they are due only to the action of these transforming factors on the generations of a remote past—although we believe he lays unwarranted stress upon their having survived only to the degree that they still continue to be adaptatively perfect and efficient, for we believe that they no longer have survival value. As to whether they formerly were survival factors, we are in doubt; for their elimination, even where the environment seems substantially unchanged, certainly warrants such doubt. Spencer Trotter, in his studies in the *Auk* and the *Journal of the Academy of Natural Sciences*, of Philadelphia, dwells on the evanescent nature of what we speak of as "faunas," pointing out that "a fauna" is merely an expression of the temporary adjustment of any group of animals to given conditions of environment—vegetation, moisture, temperature, and many other factors combining to determine or condition the environment—so that the species which embody a fauna are mobile elements, not hard-and-fast fixtures in their environment, their present phase of distribution being a sequence to their past history.

A glance at the animals of desert, or arid and semiarid regions, is interesting from this standpoint. The general color tone of the animals of arid regions is pallid and neutral, just as the general color tone of arctic animals is white and that of animals of temperate humid regions, such as the neighborhood of Puget Sound, is dark. There are, of

course, exceptions to these general rules, such as the musk-ox, raven, and wolverene in the boreal realm, or the male ostrich, black and white chat, lark-bunting, and various black or advertisingly colored lizards, like the Gila monster, in arid or semiarid lands. The rule is general, however. We do not here discuss the interesting problem of the coloration of arctic animals. But in the arid and humid regions referred to the prevalence and repetition of pale and dark types is almost certainly due to the varying degrees of sunlight and moisture. A consideration of certain forms only would make it possible to contend that the coloration was developed by natural selection for concealing purposes. But there are other forms, to which it is not possible to apply this theory, which nevertheless are also colored in the same general manner. The pale desert antelopes, such as the desert oryx, show what is simply a more extreme development of the coloration already tending to develop in their several kinds on the semiarid plains; they never hide; and their lives are led under conditions which, as we have shown in the case of the ordinary plains game, make it absolutely impossible that any type of coloration can have any survival value for them. In similar fashion, the black duck-hawk of the Puget Sound region and the pale eagle-owl of the Western American plains show each the general type of coloration of the faunas of their respective localities, and yet lead lives such that this coloration can in no way help them to secure their prey. It may, therefore, be accepted as certain that the pale desert coloration is not produced by natural selection directed toward a concealing coloration. It is possible that there exist obscure relations between pigmentation and bodily health, which have se-

cured the elimination of the darker individuals. It is infinitely more probable that the general tone of color is due to the action of the climate—sunlight, moisture, and temperature—on all the individuals of a great number of species, generation after generation, and to the inheritance of the characteristics thus chemically or mechanically acquired. We believe that this is probably a clear case of the inheritance of acquired characteristics. We have never felt that the demonstrations (for instance of Cope, in his "Factors of Organic Evolution") of the occasional and limited inheritance of acquired characteristics have been successfully refuted,* although we entirely agree with Dewar and Finn in their masterly book on bionomics to which we have already referred, "The Making of Species," that all the facts tend to prove that the inheritance of acquired characteristics is too rare and limited a phenomenon to make it possible to regard it, any more than natural selection, as a primary factor in the making of species.

We saw in Africa one curious instance of the intrusion into arid regions of a form normally belonging to an utterly different environment. In East Africa we found the black and white colobus monkeys in the depths of the cool, tall, matted mountain forests. They lived in the tops of the high trees, and came to the ground with much reluctance. They never wandered out into the hot, dry country, where plains of grass were dotted by scattered acacias, and palms

* Recent experiments have demonstrated conclusively the inheritance in guinea-pigs of acquired alcoholic characteristics; subtle Weismannic theorizing as to germ-cells and plasma-cells, and hypothetical suppositions as to the infection of the former, whether these theories and hypotheses have a scientific or merely a mystical value, do not and cannot alter the proved facts (1) that these characteristics were acquired, and (2) that they were inherited.

and thorn-trees fringed the rare streams; although the small greenish or yellowish monkeys were common in these trees near the streams of this dry, hot, open country. But in the Lado, where the country was precisely like that into which in East Africa they never ventured, and although there were no forests such as elsewhere constitute their dwelling-place, we found a form of the colobus, with the black increased relatively to the white in the pelage, living among the thorn-trees, precisely like the ordinary monkeys, and likewise trusting for safety to galloping off over the ground. Even in the great forests the colobus was far more revealingly colored than the ordinary monkey; but in this new habitat its color was an almost startling advertisement. Neither from the standpoint of cover nor of food, nor of climate nor of enemies, was it to have been expected that the colobus would so completely change its environment and life habits.

It is necessary always to remember that it is impossible to lay down laws regarding concealing coloration which shall apply both to the higher and the lower animals. The conditions are wholly different. A caterpillar which passes its whole larval life on green leaves may be permanently concealed by a green color. But a sharp-shinned hawk hunts through woods and across open fields, over snow and over green grass, in summer and in winter, through every kind of landscape; and when it attacks it normally darts with such velocity that its tint and pattern must be a mere blur to its prey. It is evident to any serious thinker that coloration may be all-important to the caterpillar, whereas it must be of minor or negligible consequence to the hawk. Again, a wood-frog or a tree-toad lives almost all its life in

surroundings with which its color harmonizes well-nigh perfectly; and moreover passes much the larger portion of its time—ninety-nine per cent of it—sitting motionless in one position. Some frogs, if their legs are extended, will seem to have five separate blotches of the same color; one on each lower leg, one on each thigh, one across the back. But when in the normal attitude there will appear merely a broad, uninterrupted stripe across the frog's back; it passes so much of its time motionless, with its legs drawn up, that the pigmentation is affected precisely as if these legs were merely lateral developments of the body. Concealing coloration in such a case may really conceal. Contrast this with the wolf, which ranges over the old and new worlds, and, in its various subspecific forms (using the term "species" with Linnæan largeness), extends over more than half of the land area of the globe, from the polar regions to the tropics. We have studied the wolf carefully in the Rockies and on the great plains; and also its smaller brother, the coyote. A wolf is a wide-ranging animal. It hunts in the white winter, the green spring, the gray fall; on the open plains and in the thick woods; and amid all kinds of surroundings of every conceivable color. Perhaps, on the average, under such conditions a slightly countershaded khaki or drab or gray would be most concealing; and there are wolves of such coloration; but in company with them in different places are white and black and red and brown wolves, and wolves of a conspicuous iron-gray; and all are equally successful. Evidently the coloration is to them, in their varied lives, a factor of no survival value, and therefore negligible from the standpoint of natural selection; the survival factors are cunning, ferocity, endurance, dash,

speed, the keenness of their senses, and the formidable nature of their weapons. This also applies to the coyote, although this small wolf does not show such advertising color phases as its big brother. If we had only the coyote to consider, indeed, we might be tempted to think of its coloration as possibly due to the survival value of its various coloration phases to the extent that natural selection may have defined the wide limits within which other forces can develop the various tints and patterns; but having in view the big wolf, with its white and black color phases, it is doubtful whether it would be correct to assign even this small rôle to concealing coloration working through natural selection. The coyote is one of the very few mammals which it is possible that the countershading may in rare instances help very slightly toward concealment; but it certainly is not a factor of survival value. The black-backed jackal, when compared with the common jackal, also shows that even an advertising coloration is of no detriment to a beast with its habits.

The foregoing remarks are based largely on a somewhat extended series of observations, in their native haunts, of the following big game and carnivores:

NORTH AMERICA

Cougar.
Lynx.
Wolf.
Coyote.
Red fox.
Gray fox.
Grizzly bear.
Black bear.
Bison.
Bighorn.
White goat.
Prongbuck.
Moose.
Caribou.
Wapiti.
White-tail deer.
Rocky Mountain blacktail.
Coast blacktail.
Peccary.

AFRICA

Lion.
Leopard.
Cheetah.
Serval.
Spotted hyena.
Striped hyena.
Hunting dog.
Aardwolf.
Black-backed jackal.
Silver-backed jackal.
Elephant.
White rhinoceros.
Black rhinoceros.
Grévy zebra.
Common zebra.
Hippopotamus.
Wart-hog.
Bush pig.
Forest pig.
Common giraffe.
Reticulated giraffe.
East African buffalo.
Abyssinian buffalo.
Giant eland.
Common eland.
Bongo.
Bushbuck (several forms).
Koodoo.
Sitatunga.
Sable antelope.
Roan antelope (two subspecies).
Oryx.
Grant gazelle (three forms).
Thomson gazelle.
Gerenuk.
Impalla.
Chanler rock reedbuck.
Reedbuck (two subspecies).
Common kob.
White-eared kob.
Common waterbuck.
Defassa waterbuck (two subspecies).
White-withered lechwi.
Abyssinian duiker (two subspecies).
Red duiker.
Steinbok.
Oribi (two species or subspecies).
Dikdik.
Klipspringer.
Wildebeest.
Topi.
Kongoni hartebeest.
Neumann hartebeest.
Jackson hartebeest.
Uganda hartebeest.
Nile hartebeest.

This makes a total of about eighty animals which, because of their size, must on the whole be looked at by hunters from about the standpoint that the big cats and the wolves look at their prey; from the standpoint that

bobcats, foxes, minks, and weasels look at rabbits, woodchucks, gophers, and mice. The animals observed were sufficiently numerous in species and individuals—of some we must, all told, have seen many thousands under every conceivable circumstance and surrounding—to give some warrant in generalizing about them. We have touched above on the coloration characters of some of them; the characters of those omitted are similar and teach identically the same lessons.

Among these animals a fair proportion are not merely not concealingly colored, but have a strikingly advertising or revealing coloration. The prongbuck, white goat, black bear, the wolf when either in the white or the black coat, the giraffes, zebras, sable antelope, wildebeest, topi, white-eared kob, and white-withered lechwi are so colored that unless screened by cover it is almost impossible for them to avoid attracting attention under normal conditions. Many of the other animals, although not so glaringly conspicuous, nevertheless possess a coloration sufficiently conspicuous to insure their being seen by any brute or human foe that trusts to eyesight at all—for instance, the pallah, bongo, bushbuck, white-tail deer, and all the plains antelopes of Africa—not one of which, from the eland, roan, and oryx to the gazelles, ever tries to escape observation or lives under conditions which would enable it to escape observation. There remains a minority of the grass-eating animals, which live in forests or swamps, whose coloration, if not exactly concealing, is at least not conspicuous. These, however, do not seem to be any better able to shift for themselves than such of their neighbors as happen to be advertisingly colored; the little antelopes that are foxy-red

do just as well as their neutral-tinted neighbors; and the same is true of their big kinsfolk. The forest and swamp dwellers of dull and uniform coloration and those of bright and varied coloration get on equally well, and are equally hard to see or kill; it is evidently the cover and the beasts' shy, wary watchfulness, and not the coloration, that count. Countershading has no effect at all of an appreciable quality as regards these animals. It may very doubtfully be of some slight help in the case of two or three of them; but even in these it is quite impossible that it is a survival factor operating through natural selection for purposes of concealment. In a dozen cases, ranging from the buffalo down to the peccary, there is no countershading, and in two cases, at least, the topi and one form of the red fox, there is inverse countershading.

We have observed and more or less carefully studied hundreds of species of the smaller mammals in both North America and Eastern Africa. We have likewise observed the birds of North America with some care, and among African birds the waders, the birds of prey, the bigger land-birds, and some of the more conspicuous smaller birds, including hornbills, night-hawks, swifts, swallows, sun-birds, bee-eaters, kingfishers, barbets, bulbuls, plantain-eaters, parrots, weaver-birds, and whydah finches. Some facts concerning the revealing and concealing coloration of these species are set forth by Colonel Roosevelt in the *Bulletin of the American Museum of Natural History*, vol. XXX, pages 119 to 231.

Thousands of species of birds which are abundant and highly successful in life, such as red-headed woodpeckers, white-headed woodpeckers, red-winged blackbirds, yellow-

headed blackbirds, grackles generally, black and white storks, oyster-catchers, black-bellied plovers, white egrets, auks, puffins, guillemots, cormorants, orioles, tanagers, scarlet ibises, flamingoes, vermilion and scissor-tailed fly-catchers, and countless others, from the biggest to the smallest, on land and on water, have highly advertising colorations, and never gain any benefit from concealment. Many of the smaller mammals, including the immense majority of mice and shrews, lead their lives under such circumstances as to make their different coloration patterns of no consequence one way or the other in concealing them, and this although their prime hope of safety from their foes lies in escaping observation. Habit and cover are all-essential in their cases; and if their coloration in any case has been affected by natural selection, it has merely been done by setting wide limits, beyond which coloration cannot transgress as regards advertising quality.

We wish to emphasize the fact that we are not now discussing the lower vertebrates and insects. From what we have read it appears clear there are certain insects which are protectively colored and which show that this is a survival factor by the care with which they light on objects with which their coloration harmonizes. What is needed to reach conclusions as regards these insects are such studies as Doctor Henry Skinner's "Mimicry in Boreal American Rhopalocera" (*The Journal of the Academy of Natural Sciences of Philadelphia*, vol. XV, second series, March 21, 1912). These studies make it evident that the extreme positions taken in this matter by gentlemen like Professor Poulton are not tenable.

As regards birds and mammals, we are in a position to draw from our studies certain tentative conclusions.

The first and most important is that both the ultra natural-selectionists and the ultra adherents of the doctrine of the inheritance of acquired characteristics are almost completely in error in their claims that they satisfactorily explain the origin of species. Mere closet theorizing is almost worthless, and artificial experiments are insufficient. What is needed in addition to such experiments is observation of animals in a state of nature, carried on by trained, competent, and open-minded men, desirous of finding out the truth. A book like Mr. Thayer's (in spite of the artistic value of some of his theories) is, we are compelled to say, in its sum a hinderance and not a help to earnest students. His first main contention is that concealing coloration is universal, or nearly so, and sufficient to account as a present-day factor for all present-day coloration. This is in flat contradiction of the facts as regards the immense majority of birds and mammals. His second main contention is that the counter-gradation of shadings is the main factor in producing concealing coloration. As a matter of fact, the countershading of a mammal's or bird's coat, when it exists, is never more than a minor factor in concealing it, and in the immense majority of cases is a negligible factor. It is almost certain that it is not a survival factor, at least with regard to the higher vertebrates, and has not been developed by natural selection working toward the production of concealing coloration, but is due to some principle or law, such as that at work in the vegetable world, which tends to make leaves darker on their upper than their under surfaces, and similarly affects fruits. Under certain cir-

cumstances this countershading tends toward the concealment of a few mammals and birds, but as regards the immense majority of mammals and birds so many other elements enter into the problem that the working of the law is negligible from the standpoint of practical effect.

There remains the general question of concealing coloration as a survival factor produced through natural selection in the case of birds and mammals. The first and most important point to remember is that, as regards the immense majority of birds and mammals, the prime factors in securing their safety are habit, if they do not trust to concealment, and habit and cover if they do trust to concealment. Most landscapes in nature are so varied and accidented and contain such myriads of differently shaped objects, such a multitude of vistas superimposed and interlacing, and such a well-nigh infinite variety of colors, lights, and shades, as to make it extremely difficult to pick out any one object of any color. This is why a thick and high forest, especially a tropical forest, offers such extraordinary protection to all its inhabitants that no coloration scheme among the adults of these inhabitants seems to be of any consequence. This is why it is so hard in a varied mountain or hill landscape to pick out a pika in a mass of slide-rock, even though he can be heard uttering his querulous note; or to see a marmot feeding; or a mountain-sheep lying down; or a klipspringer going about his daily business.

As regards the big game of Africa and America, the effect of the coloration, whether concealing or revealing, is almost or quite negligible as far as the animals' enemies or the other individuals of the species are concerned. Some of them have a coloration which may legitimately be called

concealing, others a coloration which is revealing—often strikingly advertising—but neither seems to have any effect upon their lives or their actions. If in cover they all try to escape observation at times by remaining motionless, and most of them in addition at such times crouch flat to the ground. If on the plains, and especially when coming to drink, they make no effort to escape observation; and all are easily visible. The young, almost all of them, crouch flat and motionless to escape observation, and seem to succeed equally well whether, as is generally true, they are monotinted substantially like the parents or are spotted in the way that it is possible the adult ancestral form was spotted. The prongbuck uses the white hairs on the rump in a way that looks as if designed for advertisement, and the white tails and white rumps of some of the animals have a marked advertising effect; it is possible that they may serve as signal marks for the young; but if so it is to be remarked that the young of the kinds without these signal marks seem to thrive equally well. We believe that certain general tints common to most of the animals of a given type of country—the pallidity of desert forms, the lustreless darkness of forms of a cold, humid region—are probably due to the inheritance of characteristics acquired by the animals because of the effect of the climatic conditions on all the individuals, generation after generation. Aside from this, we have found no proof that the colors and markings are due to the inheritance of acquired characteristics. In no case do we believe that any particular pattern or color of the big game is due to its survival value, and, therefore, to its production for concealing or revealing purposes by natural selection. As regards most of these animals, the

evidence is overwhelming that their coloration, whatever it may be, has no effect whatever as regards their foes or prey. As regards a very few of them, it may have some slight effect, but only to the extent that natural selection may have set wide bounds to the variation, having no effect on the pattern or color developed within these bounds. It can safely be said, therefore, that natural selection has had no effect in *producing* the present coloration of any of these animals. We wish we were able to give an opinion based on actual observations as to what the cause of the coloration is, but at present all we can say is that no satisfactory explanation has been given.

Among the big-game animals the countershading has no effect; the animals without it thrive as well as those with it; and those that seek to escape notice almost always crouch, and then the effect of the countershading practically disappears. When the white is confined to the belly of any of these big animals it has little more effect than on the belly of a frog or snake—where it has absolutely none and is never seen, and therefore cannot have been developed for concealing purposes.

We have not in this chapter more than touched on birds and small mammals, both because we have not studied them as we have studied the big game and because of a lack of space. We allude to them now because the conclusions we have drawn as to big game do not apply in anything like such general fashion to birds and smaller mammals. Among small mammals they apply to most members of the squirrel family, for instance; among species with identical habits, and often in the same species, there are found instances of markedly advertising coloration and instances

of a coloration which, at least relatively, is concealing; and neither type of coloration seems to have any effect on the habits or success in life of the wearer. Evidently natural selection has failed to find any one of these colors or patterns a survival factor so far as squirrels are concerned. The same statement applies to various other families; to most weasels for instance. But rabbits, although when in motion they have a highly advertising rear-end coloration, have a concealing coloration when they crouch motionless; and the way they lay their ears back and sink to the ground shows that they desire to take advantage of every circumstance that will enable them to elude observation.

As regards all these species, the particular pattern is in all probability not produced by natural selection; but in most cases it certainly appears probable that natural selection has eliminated all variants of an advertising type and all animals whose habits render them unable to take advantage of the natural coloration. The case of the little spotted skunk, the spilogale, as observed by Doctor Hart Merriam, is even more interesting. He writes me as follows:

VANISHING POWER OF THE LITTLE SPOTTED SKUNKS (*Spilogale*)

One night in September, 1889, when sleeping deep down in the Grand Canyon of the Colorado, in northern Arizona, near the place where the Hance Trail was afterward built, I was awakened at midnight by a sniffling noise near my head. Sitting up, I realized that a small animal was hurrying away. After running about twenty feet it stopped, but I could not see it until it moved; then its color appeared to be grayish and I mistook it for a ring-tailed civet (*Bassariscus*). I fired, and was surprised to find that I had killed a little spotted skunk (*Spilogale*). It was so near that I could not understand why I had not seen its white markings.

Five years later (October 15, 1904), my sister, Mrs. Florence Merriam Bailey, and I, accompanied by Henry Gannett, of the Geological Survey, spent a night in the Grand Canyon, near the Cameron Trail. We had no water, and no food except some canned corned beef, which made us so thirsty that we ate very little. At dusk a family of little spotted skunks appeared. They showed little fear of us, and none at all of the small fire we had kindled. I tried the experiment of tossing them pieces of the corned beef, which they seized greedily. They were on grayish rocks, against which background their black bodies were easily seen; their white markings also were rather conspicuous.

While shuffling about, searching for morsels of the corned beef, they showed no fear so long as we stood still, but if we took a quick step or made any sudden move they instantly vanished. At first I thought they had gone in among the rocks, but soon saw that they had not moved away. This struck me as so extraordinary that I tried the experiment of frightening them. This I repeated a number of times, and each time the animal or animals nearest my feet immediately became invisible. All traces of black and white had disappeared, and even the outline of the animal could not be made out against the uniform grayish background of rocks and sand. The sudden transformation was most puzzling. The moon was full, but my notes are not clear as to whether it had risen high enough to shine down into the part of the canyon where we were; probably it had not. At all events, I was utterly unable to see the spilogales in the act of changing color, and could not be positive as to how they did it. I was convinced, however, that the change from conspicuousness to invisibility was brought about, under the influence of excitement or fear, by the erection of the body hairs in such manner that the white and black markings blended to form a neutral, grayish drab, rendering the animal completely invisible. The deception was doubtless heightened by the solid black of the top of the head and basal half of the tail, for at night black areas pass for shadows or hollows—thus tending to mask the body form by cutting out the dark parts.

In most kinds of open country, as every field naturalist knows, grays and drabs are "obliterative" both by day and by night.

In camping in various parts of the West I have repeatedly observed that at night a gray horse, and even more strikingly a donkey, cannot ordinarily be seen. More than once, when standing guard or going for water, I have actually run into a donkey, utterly unaware of its presence until I came in contact with the body.

It is highly probable that an owl about to pounce upon a spilogale would be completely baffled by the transformation.

This is exceedingly interesting, from several different standpoints. At my ranch-house on the Little Missouri, the big black and white, unspotted skunks were unpleasantly common nocturnal visitors. It was always easy to see them, and they never disappeared from sight as the little spotted skunks do. On most nights they were the only animals we could see at all. A badger, for instance, once came to the ranch-house; we heard it, and thought it a skunk; but we could not see it at all until we got a lantern, as the neutral grayish-drab coloration was invisible by starlight. It therefore appears that the big skunks have not developed a concealing but, on the contrary, a highly advertising coloration at night, and have not developed any way of neutralizing its advertising character. But the evolution of the little skunks has apparently produced two contradictory results: (1) a coloration pattern which is revealing at night unless the animal is excited or alarmed; (2) the power of altering the coloration pattern under the influence of excitement or alarm, so as to neutralize its advertising character and make the vividly marked animal as inconspicuous as an ordinary animal, like a badger. Of course, these facts, if the above interpretation of them is correct, tend to show that in this case the coloration developed is, as

a survival factor, detrimental to the animal's existence, and has had to be partially neutralized by the development of a well-nigh unique bodily habit. Equally, of course, the neutralization is only partial, and apparently the animal would have been far better protected against owls and other foes if it had never developed a coloration which needed such elaborate neutralization. Owls are birds of noiseless flight, and in the vast majority of cases they must pounce on the little skunk before it has any warning of their presence; surely it would be far better protected if it did not have to wait until it believed it was about to be attacked before losing its advertising coloration. An animal like a badger, which does not first advertise itself and then, if advised of an emergency, neutralize the advertisement (I do not mean voluntarily in either case) must be in better shape than one with the complicated characteristics and needs of the spilogale.

Among birds there are many thousands of species, including whole orders and families, where the coloration is usually highly advertising, and where, nevertheless, those having such a coloration and those, fewer in number, with a concealing coloration have precisely the same habits and success in life; so that in these cases it is evident that the coloration is in no sense a survival factor, and has been produced without regard to natural selection. The young of many of these species, cormorants, pelicans, and egrets, for instance, are as advertisingly colored as the adults. But there are a few species in which the coloration is seemingly a survival factor as regards the adults of both sexes, and there are very many species in which it is seemingly a survival factor as regards the young, often as regards the adult

females, and sometimes as regards the adult males at certain seasons. There are some birds with what at first glance does not appear to be a concealing coloration, which nevertheless does really help in their concealment. The hoopoo, for instance, crouching flat, with crest laid back and wings partly outspread, obviously gains help from its coloration in escaping the observation of hawks. Night-hawks squatted on the ground in the daytime, whippoor-wills on limbs, hen-pheasants, quail, and grouse on their nests, many bay-birds or shore-snipe crouched on the beach, desert-larks, and chats on the sand, ducklings and young plovers, gulls, skimmers, avocets and stilts, female ducks, and male ducks at moulting time, are among the many birds which profit by, and by their habits show that either deliberately or instinctively they purposely profit by, their coloration.

It would at first seem as if in these cases the concealing coloration must have arisen through natural selection, especially when we see the concealingly colored individuals taking advantage of their coloration by crouching motionless, and the individuals of an advertising coloration making no effort to hide; compare, for instance, desert-grouse, larks, and chats, and young skimmers, and stilts, and moulting moor-fowl, with black and white spurred plover, black and white chats, adult skimmers and stilts, and black cock in the fall. But more careful study and consideration make it appear probable that the minute patterns in these cases have not been produced by natural selection; that natural selection has merely perpetuated the general scheme of a useful pattern, which has been produced by some other cause.

We must also remember those animals which, although not concealingly colored, yet crouch and hide precisely as if they were; the steinbok, for instance, and the white-tail deer with its red coat showing against the green foliage of spring and summer, crouch motionless and take the utmost advantage of cover. It is probable that the race experience through immemorial ages has instilled into the majority of the higher vertebrates the prime value as survival factors of immobility, and of taking advantage of cover, in order to escape observation. When other and more powerful factors intervene these two may, of course, lose all importance and be abandoned; many animals which have not developed concealing coloration, such as adult prongbuck and white goat, wildebeest and zebra, never seek to escape observation, whether by immobility or by taking advantage of cover. Nevertheless, other animals which have not developed a genuine concealing coloration, such as the bongo, and the wapiti with its pale, advertising rump, do crouch behind cover and seek by immobility to escape observation. Yet other animals have developed a concealing coloration and take advantage of it.

As regards the immense majority of birds and mammals, habit and cover remain of such overwhelming importance that coloration is either not a survival factor at all or else becomes such—that is, becomes a factor telling against survival—only if very, very striking hues are developed; and probably only rarely under these circumstances. To mice and shrews, immobility, night, and the actual physical screen of earth, grass, or snow are all-important; the coloration may be of any one of many tints or patterns without producing the smallest survival effect. This is equally true

of small birds. In temperate North America two of the most abundant small birds are the song-sparrow and the junco, each in various forms; their ranges are largely the same; their habits are alike as regards taking cover, etc.; one is streaked and spotted, one is of a slate-like unicolor, with a white belly; they are strikingly contrasted in coloration—as much as are the cock and hen ostrich; and yet they are equally successful in life. The same is true as regards indigo buntings and field-sparrows, seaside and sharp-tail finches, towhees, catbirds, mockers, and thrushes. As regards the great majority of mammals and birds, it is evident that natural selection, using concealing coloration as a survival factor, has had nothing whatever to do with *producing* their patterns and tints; and where it has worked at all—and in many, probably in most, species it has had no effect whatever—it has only been by setting wide limits beyond which the variation cannot go. In all these cases countershading has but little effect and cannot possibly be a survival factor.

There remain the numerous cases, especially numerous among young mammals and birds, where the coloration has an undoubted concealing value, probably sufficient to make it a survival factor. Although numerous, these cases are far outnumbered by the others already discussed. In most of these cases it is probable that natural selection has kept the coloration concealing, but it is improbable that it has produced either the exact pattern or the exact tint. In a few of these cases countershading helps the concealing quality of the coloration; but it usually ceases to act when the animals have most need of concealment, and crouch to avoid notice. The probabilities are overwhelming that it

is never a survival factor which operates in natural selection, or else so very rarely that it can in practice be disregarded.

In very many cases where the young are concealingly colored, the adults have a different and relatively a revealing coloration; and in very many cases where the female is concealingly colored, the male has a revealing coloration. This means, in all probability, that the evolution has been from a concealingly colored form to a form in which both sexes when adults, or else the adult males, are revealingly colored; there could be no more striking proof of the unimportance of coloration as a survival factor, and of the fact that it is quite impossible that in most cases among the higher vertebrates their present adult coloration can have been developed by natural selection. Evidently in the varied lives led by most adult birds and mammals the importance of the animal's senses, and its truculence, wariness, prowess, speed, agility, and ability to take advantage of cover so far outweigh coloration that the latter becomes negligible as a survival factor. In some cases, however, it is a survival factor; this is especially true as regards many young birds and brooding mothers, which of necessity must trust to immobility for escape at critical periods; but it is also true of old birds of both sexes in various species of night-hawks, grouse, woodcock, etc.

Spotted fawns and young tapirs, and striped and spotted chicks of various birds, probably indicate ancestors of such coloration in a very remote past, although there is no indication of a change of habitat. On the supposition that these striped and spotted patterns have a concealing value, this may mean that these ancestors were more immobile than their present-day descendants; it may mean that the

increase in the brain power or sharpness of senses of the adults has caused the coloration to become a negligible factor in the animal's success in life. But it must mean that the coloration of the adults of the present day has not been produced by natural selection for purposes of concealment.

In sum, natural selection, operating with concealing coloration as a survival factor, has played a wholly minor part in developing the coloration of the higher vertebrates. In the vast majority of cases it has certainly had no part in originating the coloration; in a very large number, probably a considerable majority, of cases it has certainly had no effect even in preserving the coloration when produced. It is possible, but not certain, nor even probable, that in a very few cases it has produced the precise existing coloration; it is probable that in a few cases it has preserved the precise existing coloration after other factors have produced it. It is well-nigh certain that in a number of cases, much less than a majority, it has had a very real effect, not by producing or preserving certain definite patterns or tints, but by setting wide limits of variation which these patterns and tints may not transgress.

As far as our observations go, in the very limited field they cover, they support Mivart's contention that the chief part played by natural selection in organic evolution is the part of a pruning-knife. As for asserting that as yet there is warrant in dogmatizing about the origin of species, and about evolution itself—why we are hardly on the threshold of the matter.

CHAPTER V

GAME PRESERVES

One of the features in the psychical growth of the last quarter of a century has been the gradual recognition by civilized nations of their duty to protect from destruction and extermination the various forms, including the nobler and more imposing forms, of animal life. Thirty years ago there was no effective sentiment against the destruction of the most interesting, imposing, or beautiful birds and mammals which our world contains. The bison and passenger-pigeon in America, the white rhinoceros and quagga in South Africa, were allowed to go the way of almost or complete extinction; and sea-elephants, and fur-seals, gorgeous pheasants and birds of paradise, beautiful egrets, ibises, and flamingoes, and many, many other strange and lovely creatures, were treated as the legitimate prey of every brutal and squalid spoiler who wished to gratify his own greed or the still baser greed of his employers and their customers by robbing the earth of beauty and destroying what never could be replaced. Too late to save many creatures from destruction, but in time to save many others, the civilized peoples waked up to what was needed. One of the first steps taken was the establishment of the Yellowstone Park as a game preserve by the Government of the United States. Many other preserves now dot the American continent north of the Rio Grande. The German Government has also

taken certain important steps. But it is the British Government which has done most. Major Stevenson Hamilton's delightful and noteworthy book on the subject gives an idea of the immense good that has been accomplished in South Africa by the establishment of game preserves. In East Africa the establishment of the game preserve between the coast and the capital of the colony has made the railroad ride through it an experience literally unique—an experience such as has never been posssible for men to enjoy before our own day. Moreover, the game laws generally in these and other African colonies, such as Uganda and the White Nile region, have been so observed that for the last decade there has been no sensible diminution of the game. The elephant, buffalo, hippopotamus, eland, and the like are in the aggregate as plentiful now as they were ten years back, the chief diminution in the elephant being among the big tuskers, while the buffalo have increased in numbers. Too much credit cannot be given to the officials responsible for this condition of affairs, and to men like Schillings, Sir Harry Johnston, Buxton, and the others who by their writings and preachings have created the public opinion which rendered possible such action as the officials in question have taken. Schillings's books, and those of Harry Johnston also, are the most effective pleas imaginable against waste and destruction of wild life. William T. Hornaday's volume entitled "Our Vanishing Wild Life" should be in the hands of every American legislator, and indeed could be read with profit by the legislators of most other civilized countries.

It is necessary to make one point, however, in connection with the movement for the preservation of game. Our chief task so far has been to awaken people to the need of

preserving the game, to the need of preventing the slaughter of birds for millinery purposes and of stopping all wanton and useless shooting of song and other birds. This is the prime need. We need to put a stop to the entire feather trade, excepting as regards the feathers of domestic or semi-domestic birds, such as barnyard fowls, common pheasants, and ostriches. We need to prevent the sale of game and to put a stop in most places to market shooting and, of course, to every species of butchery. But the partial success of the movement has developed another need; because this very success developed within its ranks an enemy who masqueraded as a friend. This enemy is the mushy emotionalist, the purely hysterical creature who is under the impression that his or her heart is soft, whereas the softness is really merely of the head. These people need to remember that in nature animals outbreed their subsistence unless they are kept down by natural foes. If the protection for them is perfect, the result is that there must be some killing off or else they will die miserably by disease and starvation. In most places, and as regards most species, our whole anxiety as yet is to see the animals re-establish themselves and increase in numbers. But as regards certain species in certain places, this result has already been achieved, and the chief trouble is now their overincrease. The prime need at the moment as regards the wapiti of the Yellowstone Park and the deer of Vermont is to provide for a big additional killing. At present, the former perish by thousands of cold and starvation, and the latter are becoming a serious problem to the farmers. The men who protest against this killing occupy a position of unpardonable folly. In the same way, in East Africa, it has been necessary to provide for

additional killing of zebras, because under protection they became too numerous, and in Uganda, the buffalo had to be taken off the protected list, and in various places the hippopotamus. Moreover, the assault on collecting animals for museums is so unspeakably silly that it is difficult to accept it as being in good faith—or, at least, it would be, if human capacity for folly were not infinite. There should be no collecting excepting for an adequate and public purpose, and if species are on the verge of extinction there should usually be no collecting at all; and purposeless slaughter committed under the pretense of "collecting" should be rigorously punished. But, if these conditions are fulfilled, it is as necessary to collect animals for museum specimens as to kill sheep and chickens for food. It is, of course, just as silly to object to killing wild game for food or for scientific purposes, within reasonable limits, as to object to killing tame animals for food or for clothing.

There are always wicked people eager and adroit in turning the folly of foolish people to their own base purposes. When we started out on our African trip, the editors of a foolish little philanthropic publication in Boston, nominally devoted to the welfare of dumb creatures, started an agitation which finally took the form of petitions in the public schools against our going. The children who signed these petitions knew nothing, and of course appreciated nothing, of what they were doing; probably they would have as readily signed a petition for the hanging either of the editors of the paper in question or of ourselves. As regards ourselves, the action had hardly the effect of exciting even amusement. But it had a distinctly regrettable effect in

tending to make people, in their contempt for such folly, include in that contempt the whole movement for the protection of wild life. It is a misfortune for any cause to have action taken which, in the public mind, identifies it with the vagaries of mere folly. It seems incredible that grown people, with sufficient intelligence to edit any paper, should fail to understand that ours was merely one of the many scientific exploring expeditions which are opening to civilized mankind a wealth of knowledge concerning the dark continent. Practically every specimen we secured and absolutely every specimen excepting a very few animals used purely for food was preserved. With the exception of about a dozen trophies kept for the private collections of the members of the expedition, and with the exception of an elephant given to the University of California, and of a white rhinoceros group given the American Museum of Natural History in New York, all of the many thousands of specimens went to the National Museum at Washington. Probably (although of this we cannot be certain) the editors of the paper in question, who started the petition, would not have started petitions to abolish all our museums; yet even a moderately intelligent child of six ought to be able to see that museums cannot exist unless collections are made for them, and that if it is wrong to collect the specimens that are put in a museum, it can't possibly be right to permit the museum to exist at all. We have no sympathy with mere unintelligent private "collecting," or with any "collections" of forms of wild life as if they were postage-stamps; and there are some animals becoming so rare that, even for the great museums, collecting should be done with such caution and care as not to harm the species. In

Africa we collected series of the white rhinoceros and whale-headed storks, because it was of great importance to have them well represented, for purpose of study as well as for general interest, in our National Museum; but nothing could have persuaded us to kill an individual of either species wantonly or merely for the sake of a personal trophy. The only warrant, but the ample warrant, for collecting them was to use them in great public museums, where they were indispensably necessary. In other words, we collected them precisely as Mr. Hornaday, some twenty-four years previously, had collected a score of American bison; just as he later collected white goats, and at an earlier date fine series of the orang-outang in Borneo, and of the elephant and gaur in India. We mention Mr. Hornaday, because no man in the United States has done more than he has done in battling for the preservation of our wild life, and because there is no man living who would be less capable of killing any wild creature wantonly, or without full warrant. He rendered a greatly needed service to science when he collected the bison above mentioned, and when he collected his specimens in India and Borneo; and we did the same kind of work in Africa.

We mention the attack of this little paper, the very name of which we have forgotten, for two reasons: In the first place, it represents the kind of folly which tends to discredit a good cause, and therefore does real harm; in the next place, it encourages similar attacks by sinister creatures who cannot even give the poor excuse of good intentions for their actions. Doubtless, the paper in question was merely silly. But well across the continent, in Denver, there was another paper nominally devoted, in part, to the same cause, which

was not silly at all, but which, when we came back from Africa, repeated the same kind of attack, in the political interest of certain representatives of what was unhealthy in both politics and in business. The paper in question was nominally published in the interest of worthy causes, like protection of children and of dumb animals. In reality, it was published in the interest of certain big financiers and big politicians, who were violently opposed to Judge Ben Lindsey, the judge of the Children's Court, because Judge Lindsey has been one of the most fearless and effective opponents of the commercialization of politics to be found in all the United States. Mr. Roosevelt heartily championed Judge Lindsey; thereupon the paper in question assailed Mr. Roosevelt for having killed a cock and a hen ostrich, and preserved their skins as well as the eggs and young birds for the Smithsonian Institution. The paper denounced this as an outrage on motherhood! The editor was guilty of a similar "outrage on motherhood" whenever he ate a hen's egg or a spring chicken—and, moreover, in such event, he was merely gratifying his own appetite, whereas the ostrich group in the National Museum is for the gratification of literally hundreds of thousands of people. It will doubtless be hard for sensible people to believe that this incident really occurred; but it did; and heated partisan sheets throughout the country actually copied the article in question.

But we must not let our contempt for the silly or sinister people who seek to twist the movement into a wrong course cause us to forget how fundamentally necessary the movement is. Above all, the people, as a whole, should keep steadily in mind the fact that the preservation of both

game and lesser wild life—by wise general laws, by the prohibition of the commercialism which destroys whole species for the profit of a few individuals, and by the creation of national reserves for wild life—is essentially a democratic movement. It is a movement in the interest of the average citizen, and especially in the interest of the man of small means. Wealthy men can keep private game preserves and private parks in which they can see all kinds of strange and beautiful creatures; but the ordinary men and women, and especially those of small means, can enjoy the loveliness and the wonder of nature, and can revel in the sight of beautiful birds, only on terms that will permit their fellow-citizens the like enjoyment. In other words, the people as a whole, through the government, must protect wild life, if the people as a whole are to enjoy it. This applies to game also. If there are intelligent game laws honestly and efficiently administered, then any man of sufficient skill and hardihood, who can once a year get a holiday of a week or two, will be able to enjoy healthy sport during that week or two and kill one wapiti or one white-tailed deer or a dozen or score of quail, or duck, or prairie-chicken, accordingly as the legal game-bag limit permits, and accordingly as his skill enables him to take advantage of this permission. The ever-growing numbers of those who do not wish to shoot, but who do love to see the wild creatures, can study them in the most fascinating of all zoological gardens, that is, in wild nature, wherever there are good game preserves. Many thousands of people can travel through the Yellowstone Park and there see deer and antelope, sheep, elk, and bear, in the most interesting fashion; in time they will be able to repeat this experience along the edges of the Grand

CHAPTER VI

THE LION

Introduction to family *Felidæ* (Cats)

The existing cats form a well-circumscribed group or family, familiar to every one as the *Felidæ*. They are very highly specialized and farther removed from the original carnivore stem than any of the other groups, or, putting it more idiomatically, they are the last word in carnivorous mammals. Their specialization concerns chiefly the shortening of the jaws, the enlarging of the orbits to accommodate the large nocturnal eyes, the development of retractile claws, and the loss of the molar teeth, the function of which has been usurped by the development of the premolars into enlarged cutting teeth. The dentition has been so reduced that the cat may be said to have but eight teeth, the four dagger-like, tearing canine teeth and the four long, knife-edged carnassial or last premolar teeth. The cat with these eight teeth and its retractile claws has battled very successfully for a place on the earth and has established itself in every corner of the world with the exception of the polar regions, Australia, and its neighboring islands. Two genera are represented in Africa, the familiar *Felis* and the aberrant genus, *Acinonyx*, of which the cheetah is typical. *Acinonyx* is characterized by its non-retractile, dog-like claws, abbreviated snout, high, dome-shaped skull, which gives the head a peculiarly spherical shape, and the slender,

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hound-like form of the body. The genus *Felis*, of which the lion and the leopard are typical representatives, has short, curved, and sharply pointed, retractile claws, a more elongated head, the skull being much lower in dorsal outline and the snout longer and more dog-like.

The Lion

Felis leo

The lion is quite as familiar to most persons as our common domestic animals and needs no description. We cannot, however, include the various geographical races in this last statement. Much diversity of opinion exists among sportsmen as to the actual existence of the differences assigned by naturalists to the various described races. Some of the hunters who have had the widest experience with lions have observed such great color and pelage variation among them that they refuse to accept the differences which naturalists have pointed out in their diagnoses. The well-known African hunter Selous is apparently one of the leading sceptics. This lack of confidence in the existence of geographical races is quite in keeping with the broad methods of comparison employed by even careful field observers, and has been shared by us in the hunting field. The comparison of a large number of skins and skulls preserved in various museums has, however, shown us the error of such ideas. The racial differences upon which the races of lions are based are so fine that they can only be detected and appreciated on the actual comparison of specimens. Our field observations on differences usually lead us astray. The extremes only of color, mane, size, and other characters are kept in mind, and the average differences are wholly obliterated or undiscoverable to us. Age characters which are dependent upon the examination of the skull sutures are seldom made in the field, and much confusion results on this account. Nothing, for instance, is more common in the literature than the statement of the occurrence of adult maneless lions. A careful examination of many museum specimens, however, has failed to find really old lions,

having skulls with the occipital-sphenoidal sutures anchylosed, associated with maneless skins. The so-called maneless lions are really immature specimens of adult size which have every appearance of being fully adult and are on that account considered so by sportsmen. Adult size of skull or body is not a reliable character of maturity; immature animals not only equal but occasionally exceed the mature ones. The average observations on the coloration of the mane are similarly misleading. Owing to the occurrence of black-maned lions occasionally in all the districts where lions occur, it is assumed that the color of the mane is of no racial value. We must not lose sight of the fact that in geographical races we are dealing with average characters and not absolutely distinctive ones, such as are possessed by species. The Cape and the North African lions are usually black-maned, while the East African is decidedly a tawny or yellow-maned race. Black-maned lions are occasionally seen in East Africa, but they occur in the proportion of about one to fifty, and are of such rare occurrence that we are quite justified in calling the East African a yellow-maned race.

It is a singular fact that the lion, though so widely separated by color, mane, and habits from the tiger, is almost indistinguishable from it in skull characters. The skulls of the two great cats are quite identical in size, shape, and dentition, although readily distinguishable in these characters from those of other members of the *Felidæ*. The skull of the lion may be distinguished from that of the tiger usually by the character of the nasal bones, which do not project posteriorly beyond the end of the maxillary bones, and by the flatter or less convex outline to the undersurface of the lower jaw-bone. But these differences are slight and at most only average affairs. Frequently paleontologists refer fossil skulls to the lion, a proceeding in which they are seldom justified. Fossil species based on skulls and obviously with unknown color characters cannot be assigned definitely to either the lion or the tiger. Large cats related to the lion or tiger were formerly much more widely distributed than at present. They are known as far back as the Pliocene in North America, Europe, and Asia. The lion at the present time occurs from western India westward

through Persia and Arabia to Africa, where it is found throughout the whole continent. In addition to this range, the lion was found within historic times in Asia Minor and southeastern Europe. The lion has recently been exterminated in Cape Colony, south of the Orange River, and in Algeria and along the Mediterranean region and Egypt generally. It is now of rare occurrence in India and Persia.

The lions inhabiting Africa proper or Ethiopia may be divided into some six or seven races, on differences in general body size, relative size of teeth and skulls, and differences in tone of coloration and color of manes. At least two of these races occur in the region covered by the present treatise, a light-colored, yellow-maned race in British East Africa, and a more tawny, shorter-maned race in Uganda and the Nile Valley. Just outside of this territory a small-toothed race, *senegalensis*, occurs in the Congo basin, and another in Abyssinia, *roosevelti*, having a very broad skull and black mane. The lion occurs everywhere except in forest or alpine meadows. He is found throughout the dry, hot deserts wherever water sufficient to quench his thirst can be obtained.

The lion is common throughout all the portions of East Africa which we visited except on the high, wet plateaux and in the dense forests; we did not come across it in Uganda; but it was found on the Lado and less commonly along the White Nile to the Sobat. There are geographical varieties; but the presence or absence of the mane, and its color—black, tawny, or mixed—represent individual and not specific or subspecific variation; black and yellow-maned lions come from the same litter, and the fullness of the mane may vary greatly among males from the same litter, although it is apt to be heaviest where the climate is cold.

The litters are certainly born at various times. Judging by the cubs we saw, one litter must have been produced by

a lioness on the Kapiti Plains in January, and another on the upper Guaso Nyiro of the north about the first of June; and in each there were in the immediate neighborhood of the litters of comparatively young cubs—three or four months old—other young lions probably three or four months older. This must mean that in East Africa litters may be born at almost any season of the year. The lying-in place of the lioness is sometimes in a cave, sometimes in thick brush or long grass. Normally the cubs remain where they were born for a few weeks, the mother leaving them to hunt, and returning sometimes after an absence of forty-eight hours; but they make no noise even when left thus long. If game is abundant they may keep to the original lair for several months, but if game is scarce, or for other reasons, the lioness may shift her quarters when her young ones are not much bigger than tom-cats, and the family may then be seen travelling long distances until another suitable place for a lair is reached. When the cubs are three months or so old, they habitually travel with the mother; then, instead of eating her fill at a kill and afterward returning to the cubs, the latter run up to the kill and feed at it with their mother. We found flesh and hair in the stomachs of two cubs; for they begin to eat flesh long before they stop suckling. While still very young they try, in clumsy fashion, to kill birds and small animals. By the time they are four or five months old they sometimes endeavor to assist the mother when she has pulled down some game which is not formidable, but has not killed it outright before they come up; and soon afterward they begin to try regularly to help her in killing, and they speedily begin to help her in hunting and to attempt to hunt for themselves.

Evidently in their first attempts they claw and bite their prey everywhere; for we found carcasses of zebra and hartebeest thus killed by family parties which were scarred all over.

Lions are sometimes monogamous and sometimes polygamous, and there is much variety in the way they conduct their family life. It is a common thing for an old male to be found alone, and it is no less common for two adult males to be found in company, living and hunting together; the two famous man-eaters of Tsavo, which for a time put a complete stop to the building of the Uganda Railroad, were in the latter category. A lion and a lioness are often found together, and in such case a strong attachment may be shown between them, and the union be apparently permanent; at least this would seem to be the case from the fact that such pairs will often remain together just before the birth of the cubs and while the latter are very little, the lion lying up during the day in the neighborhood of his mate and her litter. But it is a frequent thing to find a party of lions consisting of one old male, of two or three or four females, and of the cubs of some of the latter; and these parties are well known to the Ukamba and 'Ndorobo hunters, and their association is permanent, so that these cases evidently afford instances of polygamy. Two or three lionesses sometimes live in companionship, with perhaps the cubs of one or more of them; and a single lioness may be found either by herself or with the cubs of one litter, or of two litters. On one occasion we found a lioness associating with a young male, not yet quite fully grown but already much bigger than she was, and a couple of young cubs perhaps two or three months old; now, from information given

us by the natives, we are inclined to think (although, of course, we are not certain) that the young male was one of her cubs of a former litter, and the father of the cubs that were with them. Finally, it may happen that lions join temporarily in larger parties, which may contain two or three adult males, several females, and young animals of various ages; but we are inclined to believe that these associations are short-lived, being due to peculiar conditions, such as great local abundance of game—for lions often hunt together in order to profit by mutual support.

Lions are noisy animals where they have not been much molested; but, for some reason or other, if they are so hunted that their numbers are much thinned, the survivors seem to roar less frequently than formerly. The roaring is done at night; but once in the Lado we heard a lion roar after sunrise. There is no grander sound in nature than the roaring of a troop of lions. The old male begins, and the others chime in, at first with low moans that grow louder and louder until the full-lunged roaring can literally be heard for miles; then the roars gradually die away into gasping grunts. The volume of sound is extraordinary and cannot possibly be mistaken for any other noise if reasonably close; but, of course, if far enough distant it becomes only partially audible, and may then resemble the booming of an ostrich heard near by; and in thick cover the grunt or growl of a lion, indistinctly heard, may be mistaken for the grunt of a buffalo or the occasional growl—I know no other word to describe the sound—of an elephant, a beast which sometimes utters the queerest and most unexpected noises. It has been asserted that the lion never roars when hungry, because to do so would frighten his prey, and that this roar-

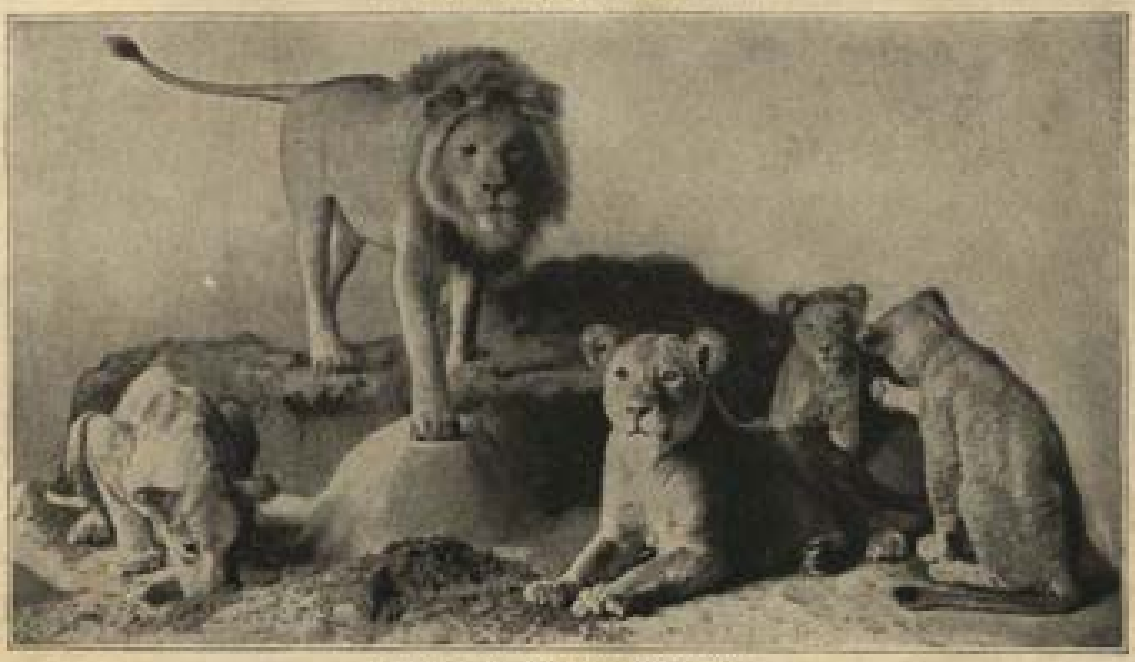
ing is a sign that he is full-fed. This sounds plausible; and yet, as a matter of fact, we doubt if it is true. Undoubtedly, after a successful chase lions roar freely; we have most often heard them between midnight and morning. But we have also heard regular roaring—not mere moaning, or the panting noise occasionally indulged in by a hungry, questing beast—soon after dark, and this was persevered in at intervals for an hour or so. We are inclined to think that generally lions are silent until they have killed, but that occasionally, whether as signals to one another or from mere pride and overbearing insolence, they roar at intervals on their way through the darkness from their resting-place to their hunting field. Of course, when they reach the actual place where they are to hunt they become quiet; unless they deliberately try to stampede the animals by roaring, or unless several are hunting together, spread out around a herd of zebra or antelope, when one may roar or grunt to scare the animals toward the others. Ordinarily lions make no sound that can alarm their prey; yet even when actually hunting an occasional hungry lion may utter a kind of sigh or moan, an eerie sound when heard close by in the pitchy darkness. On rare occasions a lioness deprived of her cubs or one of a pair of lions whose mate has been shot will roar savagely after nightfall, perhaps in the neighborhood where the loss occurred, or perhaps while travelling about. Old males may roar again and again in answer to one another as if challenging; and if one party begins to roar it will often bring an answer from any lion within hearing. At bay a lion utters a continuous growling, broken by muttered roars; and he grunts loudly as he charges. When disturbed a lion grunts as he gallops away.

Lions do not go into heavy forests, although they make their day lairs along the edges. They like to lie up for the day in patches of jungle which border on open plains; in bushes in open scrub; in clumps of reeds; in any thick bit of cover in the open thorn forests which are so plentiful in much of the game country; and perhaps especially in a strip of cover along a river, or one of the dense masses of brush and trees, of small extent, which are found along the watercourses. They also lie in tall grass. Occasionally they lie, throughout the day, right out in the open, on a mound or the side of an ant-hill, or under a low bush or tree that does not shield them from sight. If the grass is very tall they find it easy to get close to their prey and to evade human observation; and where the brush is thick or the open forest fairly continuous it is almost a chance if one comes on them. If much molested they become strictly nocturnal; otherwise, under more natural conditions, although they spend most of the day sleeping, they may sometimes be seen leisurely strolling in the open, and they often return to their resting-places after sunrise, and leave them before sunset—although even under such circumstances it is only exceptionally that they hunt except under cover of darkness. Once we came on a big male lion in mid-afternoon walking back across the open plain to a zebra he had killed on the previous night; and once, at the same time of day, we came on a lioness leading her cubs back to the carcass of a wildebeest, also slain overnight. On another afternoon we came across a lion and lioness gazing intently at an old bull wildebeest which was returning their stare, very much on the alert, at a distance of sixty yards.

Except when resting and in the breeding-season, the

whole career of a lion may be summed up in the single word rapine. For all the creatures of the wilderness, save the full-grown elephant, rhinoceros, and hippopotamus, he is the terror that stalks by night. His prowess is extraordinary. His tactics are stealth, surprise, and sudden, overwhelming fury of attack. Occasionally he hunts by day, but in the great majority of cases by night; and the darker the night the bolder he is and the more to be feared. If an animal passes close to his resting-place in the daytime he will often attack it; and in wild regions he may, if hungry, begin to hunt early in the afternoon or continue to hunt late in the morning; but that this is not common seems to be shown by the fact that if lions are abroad in the daytime, the game does not seem especially disturbed by their proximity; hartebeests, zebras, and gazelles will keep a watch on a lion thus moving up, and will not go very near it, but show no special alarm or excitement. Where game swarms and beasts of prey are abundant, and therefore often seen, the animals that are preyed on are so constantly exposed to assault that, although always on the watch and often very nervous if they suspect the presence of a lion or leopard without being able to place it exactly, they yet grow to reckon their chances with coolness if the creature they dread can be seen, and show a curious indifference to the presence of the marauders if they believe themselves safe; their moments of mad and panic terror are only when the foe actually charges, especially if he has been hitherto unseen. Animals of the open plain, which trust in their speed, seem unconcerned about the presence of a lion if far enough from him to avoid his first rush. Animals of the bush are even more confident in his presence, or at least this

HEAD OF THE LION IN THE GROUP BELOW
From a photograph by Dr. R. W. Shufeldt



GROUP OF EAST AFRICAN LIONS
Shot by Theodore Roosevelt on the Loita Plains, B. E. A.
Mounted by G. R. Turner in the United States National Museum
From a photograph by Dr. R. W. Shufeldt

LION GROUP IN THE UNITED STATES NATIONAL MUSEUM

is true of the smaller ones, which are adepts at dodging and twisting through the bushes and among the tree trunks. Once we found a reedbuck lying up in a large patch of reeds which also contained a lioness; the two animals were spending the day in peaceful rest not fifty yards apart. On another occasion we found a bushbuck at home in a thick bit of jungle, by a small river, which jungle contained a quantity of lion dens, although only one lion was at home at the time. This lion made off along a dim trail, passing by the bushbuck within ten yards; but these ten yards were filled with small tree trunks, tough, close-growing bushes, and vines, and the bushbuck, although much on the alert, evidently did not think it worth while to move.

The lion's coloration, taken as a whole, is undoubtedly concealing. Considering all conditions, white is probably the most conspicuous of all colors, and next to white among mammals comes black; while a countershaded yellow dun or dull gray is probably the least conspicuous, the most concealing. Town dwellers, or unobservant persons, are sometimes surprised to learn that even at night a black animal is ordinarily (although not always) more easily made out than a dull-gray or khaki-colored one; but all Western cowboys know that on the average a white horse is most conspicuous at night, a pied horse next, and then a black horse; while the clay-banks or yellow duns, or the dull grays, are the hardest to see. In the old days while night herding on the Western cattle ranches there would, of course, be nights when I could see nothing, or when all the animals looked alike until I was within arm's length of them; but on the average the colors of the horses and cattle were conspicuous in the order above given. Donkeys, gray and counter-

shaded, were the hardest of all animals to see, even harder than the only less invisible dun horses; at the time I attributed their greater invisibility purely to their inferior size, my attention not having been drawn to the question of countershading, which may have had some effect.

The lion's general coloration, then, is concealing, as concealing as the general body color of an eland, oryx, roan antelope, or buck of the big gazelle. The body coats of all these animals have a concealing value in their ordinary surroundings; and the habitual attitudes of the antelopes are such that the countershading would have an effect were it not that they never seek to conceal themselves and never profit by concealment. But unlike the big grass-eaters of the open plains, which always stand upright, the lion invariably squats and crouches when seeking to elude observation, so that in its case the effect of the countershading disappears at all critical moments, and is doubtless entirely negligible as an element in the beast's concealment. But this is not all. Even with a lioness the black-tipped ears are revealing, and so is the seemingly involuntary waving of the black-tipped tail. The male lion has some strongly revealing bodily attributes. His mane is conspicuous, and when it is black it has a highly revealing quality. Yet the black-maned lions are generally beasts in high condition; apparently neither the presence of this highly revealing black mane in some males, nor the absence of all mane in the females, has any effect one way or the other in helping or hampering the animal against its prey. It is therefore evident, neither the revealing quality of the black mane nor the concealing quality caused by its absence has any effect as a survival factor. The slightest reflection will convince every

EAST AFRICAN LION AND LIONESS FROM NAIROBI, B. E. A.
Presented by W. N. McMillan to the National Zoological Park.

SAME MALE LION AS SHOWN ABOVE

EAST AFRICAN LIONS AT NATIONAL ZOOLOGICAL PARK

one of the truth of this statement; but very few seem to perceive its apparent meaning; for it is difficult to account for this evident fact except by the admission that the lion's coloration is really a wholly minor, and probably a wholly negligible, element in enabling it to approach its prey unperceived—in other words, that the undoubtedly concealing quality of the lion's coloration is of interest chiefly as a coloristic fact, and plays little real part, and probably no part at all, in the animal's success as a hunter, and has not been developed by natural selection or otherwise for this particular utilitarian purpose.

The lion sometimes lies in wait at a drinking-place, especially in seasons of drought when the water-holes are few in number, and when the game is obliged by thirst to come to each of them. But of the numerous kills we came across, several hundred in number all told, only a few were by the drinking-places. The great majority were out on the plains. Evidently the lion far more frequently kills his game by stalking, still-hunting, or driving on the plains than by lying in wait at a watering-place. Unquestionably a party of lions will sometimes drive game; they spread out, and those to one side, by grunting or merely by their smell, stampede the game so that those on the other side may catch it. Ordinarily, however, the lion crouches motionless as his prey grazes toward him, or himself crawls toward it with almost inconceivable noiselessness and stealth. The darker the night the bolder the lion; under the bright moonlight a lion is apt to be somewhat cautious, whereas there is almost no limit to its daring in black, stormy weather. No matter how pitch-dark the night, the lion seems to have no difficulty in seizing his prey in such manner as to insure

its well-nigh instant death. Except full-grown elephant, rhinoceros, and hippopotamus, there is no animal in Africa which the lion does not attack, and it preys on the young of all three creatures; and in altogether exceptional instances parties of lions have been known to attack and master nearly full-grown cows or half-grown young bulls of all three of them. The giraffe is occasionally killed. In parts of Africa the buffalo is a common prey; but where other game is plentiful, lions prefer to avoid combat with such formidable quarry, and they rarely attack a buffalo bull in full vigor unless several of them are together. On Heatly's ranch near Nairobi lions sometimes laid up in a big papyrus bed which sheltered a herd of buffalo, but zebra and hartebeest and other buck swarmed near by, and during our stay the lions never meddled with the buffalo except on one occasion when a lion and a lioness together killed a young cow which they found by itself. At Meru Boma I met a visiting district commissioner, Mr. Pigott, who a few months previously had found the remains of a big buffalo bull which had been attacked and overpowered by a party of lions; the struggle had been terrific; and near by lay the body of a lioness, her flank ripped open by one of the buffalo's horns. A full-grown male lion, however, will kill a cow buffalo single-handed, and when sharp set by hunger has even been known to kill a full-grown bull, usually after a hard struggle. Of course, in such a case the lion owes his success to surprise, the attack being delivered with terrific rapidity, and the quarry taken completely unawares. Even a cow buffalo, if on her guard, would have a good chance of beating off a lion, and a bull would almost certainly do so. But if the lion can bound on his victim, fixing the claws of one fore-

paw on its face or muzzle, while the other holds it by the shoulder and the great fangs tear at the neck, feeling for the bone, he is very apt to win. In such a case the buffalo is so hampered that it cannot exert its full strength and, with its head twisted to one side, there is a fair chance of its breaking its neck in one of its headlong plunges; and unless it can shake off the lion sooner or later the latter's teeth meet through the spinal marrow and the fight is over. When several lions attack jointly they apparently interfere with one another, or else embolden one another so much that the quarry is less scientifically seized, and is usually clawed and bitten all over. Probably lions occasionally strike heavy blows with their massive, powerful forearms, but this is certainly not common; ordinarily the claws are merely used to hold the animal, and the killing is done with the teeth. Thick brush, and, to an even greater degree, long grass, favor a lion's attack, enabling him to make his rush so close up that the prey has little chance of escape; but on a bare plain the game may get just the second's time necessary to escape, and if it is a big, powerful, even though unwarlike, animal, like an eland, it may wrench itself free from a bad hold where its head or neck has not been seized, and escape.

The great majority of the kills that we saw were zebras and hartebeests; but we also came on the carcasses of eland, wildebeest, oryx, waterbuck, wart-hog, kob, impalla, and gazelle, which had fallen victims. Usually it was impossible to tell just how the killing had been done; twice we found zebras with the big fang marks on the back of the neck; we found a hartebeest which had been seized by the throat; several animals showed claw marks on their faces; a young waterbuck cow had been bitten through the head

—we think, but of course cannot be certain, that this was the way she was killed. With none of these game, not even the plucky oryx and wildebeest, did we find the slightest evidence of resistance or of anything in the nature of a fight. The oryx is said at times to defend itself against the lion; but although along the Guaso Nyiro of the north we came on a number of oryx kills, we never saw one instance in which there had been more than the usual scuffle. Evidently the surprise had been complete, and the sudden rush and immense strength and ferocity of the assailant had left no time for resistance. Young and clumsy lions, or very old and weak lions with poor teeth, may occasionally meet with misadventures in tackling a big zebra or antelope; but in East and Middle Africa, of the animals habitually preyed on by full-grown lions in their prime, only the buffalo are dangerous to them. Lions kill camels, horses, donkeys, cattle, sheep, goat, and tame ostriches; but where zebra and hartebeest swarm, as in much of East Africa, they find it so easy to catch them that, as a rule, they do not seriously interfere with the flocks and herds of the natives and settlers. But even under these circumstances an occasional lion will take to cattle-killing and to ravaging the flocks of tame ostriches. Ordinarily in killing their prey, lions keep their hind feet on the ground; but in one case where a horse was killed the lion leaped on its back; the hoof-prints showed that the horse had run for sixty yards or so before falling, and during this distance not a paw of the lion had touched earth. The marks on the dead horse showed that the lion's hind claws had dug deep into the haunches, while the fore-paws grasped the shoulders, and the teeth bit into the neck until the bone was crushed.

METHOD OF A LION'S ATTACK ON A ZEBRA
From a drawing by Philip R. Goodwin

Man-eating lions have always been fairly common in East Africa. The most noted, but far from exceptional, case was that of the two man-eaters which for a time stopped the building of the Uganda Railroad by their ravages among the workmen, until they were finally shot by the engineer in charge, Mr. Patterson. Another lion, after killing several men around a station on the railroad, carried off and ate the superintendent of the division; the latter had come down in his private car, which was run on a siding, and he sat up at a window that night to watch for the lion; but he fell asleep and the lion climbed on the platform, entered the car by the door, and carried off his would-be slayer through the window. In the summer of 1909 a couple of man-eating lions took to infesting the Masai villages on the plain around the headwaters of the Guaso Nyiro, west of Kenia, and by their ravages forced the Masai to abandon the district, and the native travel routes across it were also temporarily closed. A few weeks later we were hunting in the district; we kept the thorn boma round our camp closed at night, with a fire burning and askaris on guard, and were not molested. Near Machakos Boma a white traveller was taken out of his tent by a man-eater one night a good many years ago; a grewsome feature of the incident was that on its first attempt the lion was driven off, after having seized and wounded its victim; the wounds of the latter were dressed, and he was again put to bed, but soon after he had been left alone the lion again forced its way into the tent and this time carried the man off and ate him. Every year in East Africa natives are carried off from their villages or from hunting camps by man-eating lions. Occasionally one hears of man-eating leopards, which usu-

ally confine themselves to women and children, and there are man-eating hyenas; but the true man-eaters of Africa are lions and crocodiles. As has long been known, man-eating lions are frequently very old individuals, males or females, which have lost many teeth, and are growing too feeble to catch game, whereas they find it easy to master man, who is the feeblest of all animals of his size, and the one whose senses are dullest, and who has no natural weapons. But it is a mistake to think that all man-eaters are old and feeble animals. Where lions are much hunted it is doubtless true that they grow so wary of man that only the dire want produced by utter feebleness could make them think of preying on him; but where they are less molested, their natural ferocity and boldness make it always possible that under favorable conditions a hungry lion, not hitherto a man-eater, will be tempted to kill and devour a man, and will then take to man-killing as a steady pursuit. Many noted man-eaters—those killed by Mr. Patterson, for instance—have been full-grown male lions in the prime of life and vigor. It is worth noting, by the way, that Mr. Patterson states that in advancing to the attack on the railway camps the lions always roared loudly to one another until within a mile or so, but were absolutely silent during the hour that preceded the actual seizure of some unfortunate man. The attack of a man-eater is always delivered at night, and is practically always by surprise; but if the first attack fails, a bold lion will sometimes persevere and do his best to seize another victim. Even a man-eater thoroughly realizes that men are dangerous; he is no more apt to make a hard fight when himself hunted than is any other lion of like vigor; and when he is the hunter he always retires with his vic-

tim, as soon as he has caught it, out of reach of vengeance, although he may only go for a distance of a few hundred yards, being confident in the shelter yielded by a dark night. This is entirely unlike the lion's conduct with other prey; if a zebra or hartebeest is killed, the lion stays on the spot with his victim, and may eat it where it has fallen or drag it a few yards to a more convenient spot. Save in very wild places the lion leaves its prey at or before dawn, and may then travel some miles to its resting-place; it will probably come back the second night, unless it has been molested or has had its suspicions aroused. Lions feast on any dead animal they find, from an elephant to a dikdik, and even eat carrion. When they kill game of any size they first neatly disembowel the body, usually burying the entrails, and then either eat the heart, lungs, and brisket, or else begin straightway at the hind quarters. Sometimes, however, they do not disembowel the prey. They feed greedily, bolting strips of the hairy hide with their meat, but in one case I heard from an eye-witness of a lion's striking a dead zebra's body with its spread paws, and clawing off big patches of hide before beginning its feast.

Except man, the lion has few or no regular enemies in his prime. He will get out of the way of either an elephant or rhinoceros, and a herd of cow elephants with calves will charge any lion they find lurking in their neighborhood, and would undoubtedly kill it if it could not get into cover. Very probably a buffalo herd might, under exceptional circumstances, behave in the same way. Hyenas hang around lions to get the offal of any beasts the latter slay; and it is no uncommon thing to find the body of a hyena which has itself been slain by a lion when it has incautiously or over-

boldly ventured too near the killer's feast. Ordinarily a vigorous lion has nothing to fear from hyenas, and pays no heed to them; but hyenas are powerful brutes and, in spite of being normally abject cowards, they possess a latent ferocity which when they are in sufficient numbers at times renders them foes to be feared. Once Donaldson Smith, watching from a thorn boma at night, saw a regular pitched battle between several lions and a big mob of hyenas, in which the latter got rather the best of it. On one occasion, while lying near an elephant carcass, with Carl Akeley, I heard the hyenas which had been feeding on it throughout the night become roused to a fury of noisy defiance by a lion which approached the dead elephant a little before dawn, uttering the moaning sighs so characteristic of a hungry lion; the hyenas yelled, screeched, growled, laughed, and cackled, and apparently actually bluffed the lion, which did not venture to come to close quarters. Moreover, I am inclined to think that very old and feeble or badly wounded lions find their normal ends in the maws of hyenas. On one occasion Lord Delamere and one of his Somalis were desperately wounded by a lion he had attacked. They had to camp directly where the accident had occurred, and the lion, also very badly wounded, lay in the bushes but a couple of hundred yards away. Soon after nightfall the hyenas began to gather round the wounded lion, and eventually attacked it; the lion roared and fought fiercely, and a long battle ensued, but in the end he was overcome and eaten. The hunting-dogs or wild hounds also attack lions, and are much bolder in doing so than are the hyenas. Mr. Paul Rainey saw a small pack of them harrying a big lion, which was skulking off in much alarm; whether the wild hounds

ever actually kill a lion we cannot say, but they certainly sometimes harass and cow them and force them to slink off in terror. Lions have been known to eat leopards. With the other man-eaters, the crocodiles, relations are more equal. Unquestionably, lions have on rare occasions been seized, dragged under, and drowned by big crocodiles; a big, hungry crocodile accustomed to seizing animals while they are drinking at the water's edge would seize a lion as soon as an ox. But the lion also at times kills crocodiles, catching them while they are lying on the shore. A trustworthy elephant hunter whom we know writes that in the neighborhood of Lake Rudolf he found a number of skeletons of crocodiles which had evidently been killed by lions; and the natives assured him that at this point lions frequently pounced on and ate crocodiles. Doubtless the lion, like other animals, varies in character and habits from place to place; and if by any chance a single lion in some particular locality learns how to prey on an animal not ordinarily attacked, other lions may readily learn to follow his example. At any rate, it sometimes happens that lions in one district as compared with those in another district have entirely different customs as to what game they prey on; as I have said above, in some places they make buffalo their especial quarry, whereas in others they never molest the formidable wild cattle if zebra and hartebeest are to be obtained. This is like the American grizzly bears, which in some localities feast on carrion, and in others attack cattle at times and kill game; whereas in yet other localities they never kill anything larger than a gopher, and pay no attention to the carcass of a dead animal.

It is unsafe with any animal, and especially with an ani-

mal of such high and varied development as a lion, to try to lay down invariable rules. Speaking generally, lions are bold and dangerous to men at night, and exactly in proportion to the darkness of the night; on black and stormy nights a lion's daring is sometimes almost incredible. Even where there are no confirmed man-eaters a solitary man is never safe after nightfall if walking through a country where lions are numerous; if one is encountered it will probably get out of the way, but there is always the chance that it will attack. For instance, in photographing lions with the flash-light at night, there is always danger in going out to reset the flash-light; if a lion is in the immediate neighborhood, it is always possible that it may charge. Mr. Coolidge, of Boston, is one among several men we have known who have had such experiences. In daytime there is usually no danger whatever in meeting unwounded and unharassed lions, unless they are actually stumbled on in thick cover; they may growl or stand and stare ominously, but if unmolested they will almost always retire. But two of the friends we met in Africa, Mr. Percival, the game ranger, and Mr. Harold Hill, have had uncomfortable times with lions which they met in broad day. Mr. Percival was riding through some fairly tall grass when a lion charged him and soon overtook the galloping, frightened horse; Percival leaned over and yelled in the lion's face; thereupon it drew up, but again came on; the horse was now at full speed, and reached the open plain of short grass ahead of the lion, which then halted. Probably this lion at first mistook the horse for a zebra, and it halted when it discovered it was pursuing a man; yet it again came on, and would probably have overthrown both horse and rider if the stretch of tall grass had not come to an end. Mr. Hill,

while unarmed and walking along the wagon trail to his house, in the middle of the day, suddenly came on several lions in the middle of the road; they lay watching him and declined to move; so he walked off to one side and round them; whereupon they rose and followed him nearly to his house, slinking along through the patches of thin cover. They did not attack him; but they were certainly not following him with friendly motives; and the walk home with such attendants was distinctly uncanny.

When hunted, the lion certainly stands high in the category of dangerous game. There has been endless discussion and endless variety of opinion among experienced hunters as to which animal is the most dangerous. Nor is this discussion confined to African game; the same diversity of opinion as to the relative danger of hunting on foot the tiger, the Indian elephant, and the various wild oxen, such as the buffalo, obtains among men who have hunted in Asia; and this is likewise true when we consider the grizzly bear and jaguar. Enough attention is not paid to the wide differences of character among individual animals of the same species—just as among individual men; and moreover, the surroundings under which one kind of animal is dangerous may be the very surroundings under which another, normally more dangerous, would be less dangerous. On a level, open plain a fighting buffalo bull, or even a fighting tusker —elephant—would be rather more dangerous than a lion or leopard, because harder to stop—at least the buffalo would certainly be harder to kill, turn, or stop than either of the big cats, and the tusker very much harder to kill or cripple, although perhaps easier to stop or turn. On the other hand, the buffalo would be less apt to charge than the ele-

phant, and very much less apt to charge than either the lion or leopard. In most kinds of cover, however, the lion or leopard would, from every standpoint, be more dangerous than the buffalo or elephant, unless it was cover that would not hamper either of these big animals and would hamper anything smaller. There is thus every allowance to be made for changed conditions and for the wide variation of temperament among individuals. Moreover, there can be no doubt that in certain localities all the animals of a given species show an unusual development of certain traits compared to the aggregate of individuals dwelling in another locality; and so in one locality the buffaloes, elephants, rhinos, leopards, or lions may be much more dangerous than in another locality.

Taking the average of individuals and the average of surrounding circumstances, we consider the lion more dangerous to the hunter than any other game. The leopard is an even greater adept at hiding, is even quicker and more reckless in its charge, and is smaller and more difficult to hit; therefore, we consider that a fighting leopard is a trifle more likely than a lion to get home when it charges; but it is so much smaller and less powerful that it is far less likely to kill its antagonist—very few hunters have been killed, although many have been mauled, by leopards—and a few good dogs will not only stop but themselves kill a leopard, so that with dogs it can be hunted with entire impunity. Under many, perhaps most, conditions, a fighting bull buffalo offers a rather harder proposition than a fighting lion, because the huge, massive creature is far more difficult to stop when he does charge, and because he usually shows the most vindictive and ferocious resolution when,

after being wounded, he finally makes up his mind to fight; but a buffalo is not nearly as apt to charge as a lion, and is far more easily seen and far less quick in his movements, and in most cover is more easily evaded; so that on an average we do not consider that the buffalo is as dangerous. Elephants are much more apt to charge than buffaloes; a herd will charge under circumstances when even lions would slink quietly off; and in consequence to hunt them seems to us about as dangerous as to hunt buffalo; but the actual charge of a single elephant does not seem as dangerous as the actual charge of a lion or buffalo. The rhinoceros we regard as on the average much less dangerous than lion, leopard, elephant, or buffalo; in fact, as only about as dangerous as, or very little more dangerous than, the grizzly bear. But it must be remembered that these are only our personal views; and while we believe that they are shared by the majority of the big-game hunters most competent to speak on the subject, we are well aware that many equally experienced and observing hunters are on record as expressing widely different views. Good authority can be produced for the statement that the buffalo, or the elephant, or even the rhinoceros, is the most dangerous, and the lion or the leopard the least dangerous; and different observers have arranged the five animals in every conceivable order, as adversaries. The truth is that in this matter there is such wide, individual variation, both among the hunters and the hunted, that every general statement must be made with full knowledge of the many exceptions that exist thereto. There are circumstances or occasions under which the chase of each of the five animals—six including the white rhinoceros—may be very dangerous; while under other con-

ditions a number of each kind may be killed with the minimum of risk. They are the only kinds of African game the chase of which can ever be properly described as dangerous. A hippopotamus, however, will sometimes charge a boat, both unprovoked and when it has been wounded; and of course many other animals in Africa, as elsewhere, will show fight if cornered and rashly approached too close. The roan antelope when wounded will charge savagely from some little distance, and is then more dangerous than any American animal except the grizzly bear, and more dangerous than any European animal whatever, with the possible exception of the brown bear; the sable is almost as dangerous; then comes the oryx; then the wildebeest or gnu. Probably none of the deer of northern lands are as dangerous as any of these. The bushbuck, in spite of its small size, and the koodoo, waterbuck, hartebeest, and also the zebra and wart-hog, will turn at bay, but we consider them as formidable only in the sense that a bull moose or wapiti is formidable; that is, under all normal conditions the element of danger in their chase is entirely negligible. Eland and giraffe are exceptionally mild-tempered; yet the giraffe will drive both the big zebra and the oryx from a water-hole, although giving way to rhinoceros and elephants.

The chase of the lion, if fairly followed, is an enthralling, but certainly a dangerous pastime. Of course, a few lions may be killed under such circumstances that the hunter is practically in no danger whatever; and in certain forms of hunting lions, such as sitting in a tree or a high thorn zariba and waiting for them to approach a carcass or a tethered domestic animal, the element of danger is eliminated.

Moreover, the experience of Mr. Paul Rainey, who, in company with Mr. Heller, took to Africa a pack of American bearhounds and fighting dogs, and by their aid killed about sixty lions, shows that with thoroughly trained dogs of the right temper lions and leopards can be pursued by good hunters with the minimum of risk and almost the certainty of success. But the man who on foot or on horseback, without dogs, follows lion hunting as a steady pursuit will not kill many of them without being viciously and resolutely charged, and if he persists long enough his life will be put in jeopardy. During the last twenty years scores of white hunters have been killed by lions, elephants, buffaloes, and rhinos in East and Middle Africa; and the lions have killed much more than half of the total number. Except Mr. Rainey, who worked with dogs, Lord Delamere has killed more lions than any other man we know—fifty-three; he was badly mauled on one occasion, and has now given up hunting them, stating that no man can count on killing more than fifty lions without himself being killed or fatally injured. Mr. Roosevelt and Kermit killed only seventeen lions between them, two being cubs and two not much more than half-grown; and thirteen full-grown lions are too few to permit of free generalization as to their fighting capacity. Three of these thirteen lions—two big-maned males and a lioness—charged with the utmost resolution, from a distance of nearly two hundred yards when wounded and brought to bay by the pursuing horsemen; three others (all male lions) were at bay and were about to charge—one had begun to trot forward—when killed; five were killed or disabled under circumstances that gave them no opportunity to charge; two (both lionesses) were killed close up, after

being wounded, under circumstances which seemed to invite a charge, yet they made no effort to charge. Only one other lion was shot by any other member of our party—a lioness killed by Alden Loring; she charged with the utmost resolution when mortally wounded, and died while still charging. This short experience, taken by itself, would tend to show that a full-grown male lion is rather more apt to charge, and is rather more resolute in charging, than is likely to be the case with a full-grown lioness (save where the latter has young cubs); but it is impossible to generalize on such insufficient data. Tarlton, who was with us, a noted lion hunter of long experience, was inclined to think that on the average the lioness was a little more apt than the lion to charge. Probably the difference in this respect between the sexes is not great, while the amount of variations among the individuals of each sex is very great indeed. A beginner might readily kill three or four lions without danger; and he might be charged and killed by the first one he attacked. If the sport is persevered in, the man who achieves success must possess coolness, wariness, resolution, and reasonable skill with the rifle; and now and then he will need to show all these qualities.

Lions can be hunted in many ways, aside from lying in wait for them at night and from hunting them with dogs. The three most satisfactory ways are to trail them in the early morning, just after they have begun their return to their day lairs, to drive them out of thick cover by a line of beaters toward the previously stationed hunter, and to gallop them down on horseback, usually after having roused them from the shelter of some patch of bush, trees, reeds, or

long grass in which they have been lying. Often, moreover, especially just after sunrise or before sunset, alert and energetic hunters will stumble on them by accident or run across them when they are just ending or beginning their night rambles. There is luck in all hunting; but more in lion hunting without dogs than in the chase of any other big animal of the regions where it dwells, for the lion is far harder to find and see than any of the big grass-eaters that live under similar conditions. One man may never see a lion in a year's hunting; another in the same time may come across a couple of score.

In both tracking and driving the hunter is, of course, on foot. Tracking can only occasionally be employed with lions, as their spoor is so much more difficult to follow than that of hoofed animals, and as they are experts at hiding and skulking. But it can occasionally be employed in the early morning when the dew is heavy on the grass; and in long grass it often pays to follow a band of lions for some time, as they make fairly distinct trails, and frequently move slowly off before the hunter, grunting now and then. A shot at an unwounded animal under these conditions is not very dangerous, for the animal has not been harassed or injured, and rarely charges until hit; while the shot is usually taken at a distance that ought to enable the shooter to kill or cripple his game. Driving is followed in the usual fashion; a rocky hill, a valley of long grass, a reed bed, a fringe of trees, or a patch of scrub being beaten through by a line of shouting natives. The lion rarely charges back at the beaters, although it is always well to have a man with a rifle accompany them. The hunter himself in these cases is very rarely charged before shooting, for the lion has

not been baited and does not feel that it is cornered. But, of course, as the hunter is on the ground, perhaps seventy or eighty yards from the lion, it behooves him to use straight powder.

Riding lions, as it is termed—that is, running them on horseback until they turn to bay, and then shooting them on foot—is a more exhilarating, a less fatiguing, and, on the whole, a more dangerous sport. Usually two or more mounted hunters go out together. They may spy a lion in the open, or they may rouse him from his day lair. In either event, they run him hard over the open plains until he comes to bay—either on the bare open or in a bush. When he is thus brought to bay he is far more apt to charge than is the case with an unwounded lion shot by a man on foot. In any such case, and of course especially in the case of a wounded lion or of one suddenly surprised at very close quarters, if the lion is approached too close it may charge without any warning. If a man on horseback gallops too close behind a fleeing lion, it may whip round and charge him without a moment's pause. But when brought to bay, and when the hunter is some distance off, the lion usually spends some little time in threatening and in working itself up to the final pitch of fury. It stands erect, the head held lower than the shoulders, the tail lashing from side to side, and all the time it growls hoarsely, the lips drawn down over the teeth like those of an angry bear, or, more rarely, drawn back in a prodigious snarl. When just on the point of charging, the tail is usually thrown stiffly up two or three times, and if it changes its course during the charge the tail is slued to one side like a rudder. The animal may break into a gallop at once, or it may begin by trotting with the

tail erect. One of the lionesses that charged us came on with occasional great bounds; but all the other lions galloped like huge dogs. The pace is very rapid for one or two hundred yards. A horse which is standing but a hundred yards distant may be caught before it has time to get into a full gallop. Usually the lion, when it does charge, charges with the utmost determination; and, as we have said, it is more apt to charge when brought to bay on horseback than in other kinds of hunting; but it is also comparatively easy to kill under these conditions, for it advances from some distance in open country upon a man fully prepared and expectant. Moreover, it is much more easily killed or crippled than is the case with the bigger kinds of dangerous game. A fair shot who is cool-headed and has a good rifle ought under these conditions to be reasonably certain of stopping the lion before it can get to close quarters. Occasionally, if a man stands stock-still, even with an empty gun, a lion after running straight at him will at the last moment swerve; this is not ordinarily true, however; but if of two men together one runs when the lion is close, it will usually seize the runner. When it comes to close quarters it may rear and strike with its fore-paws, but far more often runs in on all fours, like a dog, knocks the man down as it seizes him, and then lies on him, using the claws to hold him, and doing the killing with its great fangs. If it seizes him by the throat or head he is killed instantly; but in the hurly-burly of the mellay the beast seems to lose somewhat of its "instinct for the jugular" and bites repeatedly at any part that is nearest—arm, leg, side, or chest. In consequence, if help is at hand, the lion can usually be killed or driven off before it has killed the man; although the

latter may die of his wounds later. While in East Africa we met many more men who had been badly bitten and clawed by lions, but who had recovered, than we heard of men who had been killed by them, or who had died of their wounds. The wounds should be cauterized at once, to avoid blood-poisoning, as the lion's teeth and claws often seem to contain some poisonous element, perhaps minute particles of dead matter. Moreover, the lion often bites deep, and with closed jaws pulls the muscle loose from the bone, thus causing the deep-seated tears which become sources of corruption. Finally, the shock of the bite is tremendous, the full muscular power of the great jaws being brought into play. Many men die from the shock. On the other hand, it so numbs them that at the moment little pain is felt. We saw a dozen men who had been bitten. One, on whom the lion had lain for some time while biting him, had suffered much; all the others assured us that at the time and for several minutes afterward they did not suffer at all. The process of healing is long and painful. Most of the men who die from lion wounds die from blood-poisoning several days after being mauled, and not directly from the mauling.

The hunter should never go near a lion until it is dead, and even when it is on the point of death he should not stand near, nor approach, its head from in front; for a lion at its last gasp will summon all its energies for one final attack, flinging itself on the man who has thus incautiously approached it, especially if it can see him, and spending its last dying moments in biting him. Necessarily, lion hunting has elements of danger if legitimately followed; for a slight deviation in aim—possible enough to any marksman

when the target is coming on at a gallop—may mean a mauling; but most accidents occur because of some bit of carelessness or recklessness, some lack of caution or preparation, of the kind that ordinarily brings no retribution, but which it is always possible will invite disaster.

The fault may lie in the overeagerness and ignorance of a beginner; it may be due to lack of nerve or timidity—and sometimes vanity will induce timid men to venture into a field for which they are totally unfit; or the mischance may occur to a keen, experienced hunter whose skill, hardihood, and prowess have finally led him to feel an unwarranted contempt for the game. This last was the cause of the lamented death of George Grey, the brother of Sir Edward Grey, the British Minister of Foreign Affairs, who was killed by a lion the year after we left East Africa, while out hunting with Sir Alfred Pease and Mr. Harold Hill, the two men in whose company I killed my first six lions, and not more than half a mile from where my first big male lion was killed. We had met George Grey in Africa and again in London; he was a singularly fine type of man, very modest, utterly fearless, as hard as nails, and probably as good a man in a serious emergency as was to be found in all Africa. Shortly after Kermit killed his two bongo, a cow and a yearling, Grey killed a bongo bull, which he gave to us to complete our group for the National Museum. He had done much hunting of dangerous game and was so fearless and possessed such prowess that he underestimated their dangerous qualities; elephants he held in some slight respect, but we heard him say that he did not regard buffalo as more dangerous than tame cattle, and he cared but little for lion, and nothing for rhinoceros.

Pease, who was out with him, is an exceptionally good hunter, a fine rider and shot, very hardy and cool. He has killed very many lions, a number of them under circumstances of much hazard; and, being a close observer, he has been struck by the wide variety of conduct among them, and the occasional great danger from them; and he combines to an unusual degree extreme boldness with very good judgment. After we left him in East Africa, he wrote describing two lion hunts in which he had taken part, Harold Hill and his brother Clifford being along. In one a lioness literally behaved like a cur; she got into a thicket and would not go out until he fired buckshot into it, and even then, although slightly wounded, she ran like a rabbit and was killed like one. In the other hunt, a big-maned lion fought with savage ferocity, charging the mounted men again and again, almost escaping, and finally being killed in full charge at the distance of a few feet by the rifles of his three pursuers. Pease then went back to England, but returned to Mombasa early in 1911 in company with George Grey, who went with him expressly to try riding lions on the Kapiti Plains. The fatal hunt occurred on the 29th of January. In a letter Pease writes of it as follows:

During the voyage Grey often talked of lion hunting and told me he had never seen lions "ridden" and bailed up, the method I had found so successful for many years. I explained to him on several occasions what was required and how it was done and over and over again impressed on him certain rules, which if observed reduced danger to a minimum. The rule I pressed most was when galloping a lion *never* to get within 200 yards of one and that it must never be forgotten that no horse can get away from a lion with only 100 yards start: but that with a fast handy sure footed pony on sound ground a lion could not catch

you if you had 200 yards start of him. I told him he must have a good steady fast pony, and he cabled to Nairobi while en route to have one sent to my place. I told him that unless the ground was very sound and open I kept off lions (when "riding" them) at least 300 yards and that I never went anywhere near them on rough cracked and broken ground where a pony could not gallop, nor into high grass. I also told him that when we bailed up a lion we always waited, at a safe distance, till the others came up and our gunbearers with heavier and more powerful weapons: and that whilst riding the lions we carried handy rifles, I myself always a .256 with which I might shoot at long range but never at close quarters. He often talked of the degree of danger in hunting dangerous game; he did not think there was much danger with buffalo saying that he had shot scores of them and he had found no more danger than there would be in shooting cows: he did not think rhino dangerous but thought lions very dangerous; but to his mind elephant hunting under the conditions he had been used to the most dangerous of all. I often said nothing is so dangerous as a lion and no shot will save you with any certainty in a lion charge but a ball in the brain, a shot that can only be fluked, for you have to hit a thing no bigger than a partridge with your bullet and which you cannot see, and have no time to draw a bead on, that is coming at you at the pace of the fastest greyhound. I estimate a lion covers 100 yards in his charge in 3 seconds, perhaps less. Were it possible to draw a bead on his head between or above the eyes he would have passed under your bullet's course before you had pressed the trigger. I also discussed with him the merits of modern cordite rifles and urged that powerful penetration and shock with steel enveloped and nickel-coated bullets gave no advantage over old fashioned big bores and solid lead bullets either soft lead or hardened lead, when it is the case that you must smash down with a huge blow a lion *within* 30 *or* 15 *yards* of you. He was inclined to agree with me but said that for himself he had more confidence in hitting a lion right when charging with a light rifle that was familiar and handy than with a heavy .450 cordite and he added these words "I can never shoot so well with a heavy rifle."

I told him I never went near a lion without having in my hand

an antiquated 10 bore (invisible rifling), black powder long barrelled hammer gun carrying a heavy charge of black powder and a heavy solid lead bullet, that no lion had ever got at me with this in my hand but I did not believe that any man could alone be certain of stopping a lion with any weapon, that I had on one occasion put a 10 bore solid lead bullet in a charging lion's neck low down at 9 paces and for anything I knew had missed him and a second similar bullet an inch or two above the first broke his neck. On the same occasion Mr. Harold Hill at my side hit the lion at 9 paces in the nose (just at the base of nose, with .404 cordite) and he too might just as well not have fired that shot at all for anything it did to check the lion. The lion that charged George Grey had his head up the last 20 yards of his charge; I doubt if Grey saw anything but mouth, nose, hair, and a tawny mass catapulted at him.

On the 29th of January 1911 a rendezvous had been fixed at Lanjoro with Messrs. C. A. and H. D. Hill for 8.30 A. M. the place being situated between their place Katalembo and my farm and residence; and handy to the ground we thought of drawing.

Lions had destroyed many of my ostriches at Kitanga, four had just been seen on a rocky hill, Kilima Theki, on my ground, and the Hills had news of 2 lions the day before not far from Philip Percival's (Potha farm). Captain Slatter and the Hills were most anxious to get rid of these brutes and my party were very keen to assist and have the chance of killing them.

Our party from Kitanga consisted of—

1. *Captain Slatter* carrying a double .450 cordite rifle, and his gunbearer. He undertook to stand by Grey at the post he was to occupy on Theki hill which it was decided to drive first. Captain Slatter was mounted on a little slow, weak Somali pony.

2. *George Grey* carrying his .280 Ross, and his gunbearer his shotgun. He was mounted on a strong, rather slow, but good pony hired from Newland and Tarlton.

3. Mr. Howard Pease carried a .256 Mannlicher and his gunbearer a Holland and Holland .390 (? or .375 ?) cordite rifle and was mounted on a very good pony hired from the Boma Trading Co.

Mr. Clifford Hill undertook to stand by him during the first drive.

4. Mr. Edward Pease carried a .450 Lancaster cordite rifle and his gunbearer a double barrelled Purdey .500 express rifle and I took charge of him during the first drive. He rode a bay sudan arab.

5. Myself. I carried a .256 Mannlicher and my gunbearer a double barrelled 10 bore. I rode a good pony purchased at Nairobi. The Katalembo party consisted of

6. Mr. Clifford Hill who carried a .404 Jeffrey cordite rifle.

7. Mr. Harold Hill who carried a .450 (?) cordite rifle, and shotgun with bearer. He took charge of the beaters and the management of the first drive. They had a mule with them.

On reaching Theki hill Grey and Slatter and gunbearers took one post: Howard Pease and Clifford Hill, and gunbearers another; I took my son out onto the open plain so that I might round up any lion that broke cover and left the hill.

H. Hill drove the hill round and just when the drive was over a lioness was started in some bush between the rocky sides of the Kopje and the plain. Grey got a long shot (180 yards) at her standing and had rather alarmed Slatter by abandoning a safe post and running down after the lioness into the bush. Grey missed his shot and for awhile the lioness was lost in the bush but from the plain below I saw her lobbing along across open patches in the scrub and then lie down in a small bush surrounded by long grass. I left my gunbearer with my son Edward Pease telling my son to keep his eye glued to the bush and mark her if she went away and if she came to him to leave her alone unless she attacked. Then I galloped up through the scrub to where I could see Grey and Slatter standing, and told them we had her marked down. I intended them to wait there or a little nearer the bush she was in till the whole party came up but to Slatter's and my astonishment in spite of my calling on Grey to wait he started to run as fast as he could towards the bush I had pointed out. He was about 30 yards from it when I managed to get up to him on my pony. I begged him to come back and wait, but he hurried right up to it, and I, in great fear that we should both be downed by her, ran up to him hoping she would not charge

before at least a gunbearer or Slatter joined us (they were hurrying after Grey). To my relief my son and party below in the plain shouted and signalled that she had left the bush and gone up the rocks. If she had been there it was an even chance that she would have charged Grey and me and when I saw he had only his little Ross I was alarmed: but regarding him as an experienced, confident, and fearless man I felt he would not like me to find fault, and I only said, "you know you ran right to the very spot where she was and I expected her to charge out." He was breathless with running and just smiled.

We decided to leave her alone for another day and proceeded across to a donga that runs down from Wami (on the Theki side of Wami) and joins the main dry donga that runs east of Wami into the Potha River. On reaching this donga (which is the one where Col. T. Roosevelt killed his first lion) my gunbearer found the spoor of two lions going down. We drew this donga down, I myself riding a little wide of it on the Wami side in order to hold up any lion that broke away on that side. Others were riding out on the Theki side. After drawing the donga down about a mile, Clifford Hill walked across to me and said "they are going to draw that donga on to the junction; we will cut across here (pointing south) and draw the main donga and cheetah bush down to them." Taking some boys we did this, Clifford Hill and the boys walking in the donga and I riding on the east side to hold up anything that might break that way: anything that broke the other side would be in full view of the main party. We drew the cheetah bush blank and our boys joined the main party at the junction. I was then about ½ a mile from the main party on the east side and just about to come down and join them and get on to lunch at the water at Potha, when Clifford Hill ran up to me on foot and was joined by two boys and said it was just about here the 2 lions were seen yesterday. I saw my son's bay arab being led and called for him and told Hill to mount the horse which he did. We rode up the hill and the boy showed us the little thorn bush with unmistakable evidence of the truth of his story. Clifford Hill then said "we had better go on a bit and then we can draw the little spruit running down to where they (*i. e.* the party) are, it is a likely place for them" (the lions). We

were now about a mile from the party at the donga and above them on the hill side and getting near the top of the spruit we were going to draw down, when we both reined up and Hill looking towards the ridge (towards Bondoni) said "what are those?" I saw two objects in the distance near the sky line and said "they look rather like ostriches." Hill said "are you sure?" and I got out my glasses: he said "I am sure they are lions" just as I with my glasses came to the same conclusion. We at once sent the boys off to inform the main party, and off we started for nearer inspection, discussing where we could turn them to. We both agreed there was a chance of their stopping in the cheetah bush if we could get their heads turned that way. We were galloping fast and the lions were galloping too; but the rear lion, slower and fatter than the other, was getting behind: so I suggested not pressing them too much, and Hill also thought that if we kept well to the left behind them they would be more likely to stop in the cheetah bush donga. "Anyway we must not let them get up Wami," he said. After going thus about a mile, and the heavy slow lion who objected to being hurried losing ground all the time, Hill said "look here, I will take the leading lion, you stick to the big one" and off he went to get on terms with the fast lion now ¼ mile ahead of the other.

My lion went very slowly down to the donga, and the other lion and Hill were going up Wami side when my lion reached it. I lost sight of him for a minute here and as I was rather near and did not like the look of him I pulled up and waited to see him come out hardly expecting he would go any further. I was a minute or two watching the spot where he had gone into the donga and then saw that he had come out further down and was rapidly catching up to the leading lion. Hill was now ½ a mile ahead of me, so I just put pace on and caught up with him. Both the lions were now turning off Wami and my lion had now passed Hill's lion and I was thinking of nothing else but where they would stand and guessed it would be in the little donga (towards Theki) when Hill called my attention to Grey and Howard Pease, who I saw to my surprise galloping hard directly behind the lions, perhaps 350 yards behind, but gaining on them. Hill shouted to me "They will drive them right up Wami; we must

get ahead; for goodness sake stop them." We were still galloping, and till that moment had never thought of anyone else interfering so that I felt certain that we had both lions collared and safe, and should hold them till the whole party came up. I could see no one else in sight besides the two who had appeared so suddenly upon the scene. I yelled waved and blew my whistle as hard as I could; but Grey, who must both have seen my frantic efforts and heard the noise, paid not the slightest attention, and to my surprise I saw him gaining rapidly on the rear lion, Howard Pease coming across to me in response to my screams and signals. Still, I never dreamt that Grey was going literally to try and ride them down and was more annoyed than anything else that the lions were being pressed up the hill just as we had begun to turn them down it. Then Hill called out, "Grey is getting too near." What happened next all took place in about 4 seconds and as quick as you can think and see. I put the facts down as they flashed on me—

Moment 1. Grey galloping hard 100 yards directly at the tail of the rear lion, the other lion some 60 to 80 yards ahead of the rear lion.

Moment 2. The rear lion whipped round and stopped (as did the other) for a moment. Grey 80 to 90 yards directly below him on the hill side.

Moment 3. The lion charged at once.

Moment 4. Grey leapt from his pony in a flash and stood in shooting attitude all in the same moment, the lion then say 40 yards from Grey. (Hill is positive that Grey dismounted before the charge began).

Moment 5. Lion at 25 yards. 1st shot from Grey. No effect.

Moment 6. Lion at 5 yards. 2nd shot immediately after 1st. No effect.

That is *what I saw in say 4 seconds of time.*

This is what happened on our side—

Hill cried out to me at moment 1, some despairing exclamation, such as, "My God they will have him for a certainty," and leaping from his horse said "shoot him, shoot him."

At the moment 1 I was bewildered with horror, and hearing Hill's appeal "to shoot" pulled up dead and had got to the

ground; when I saw the lion prepare to charge and charge all at once. I had just got my rifle to my shoulder and had cried to Hill "it is too far, it is over 300 yards" when Hill said "shoot! shoot! 200 yards" and he fired. His bullet falling short by about 10 feet, he as a last desperate chance took two hurried snap shots. Realising the position, conscious that Howard Pease was either on his feet or pony close by, I leapt to my horse, and galloped over roughish ground in the hollow dividing me from Grey with H. Pease, my eyes fixed on the horrible scene in front of me. The 300 yards seemed like half a mile and the lion lifted his head when we got within 50 yards and ceased mauling Grey. At about 20 yards or 25 yards we left our ponies and hardly got to the ground and ran in when Hill who had not stopped to remount but ran with great speed was there too. The rest of the story is not what I seek to dwell on—Hill gave the lion the knock out shot with his .404 before it jammed. I fired 3 shots. The position was rendered worse by the other lion preparing to charge and grunting less than 100 yards above.

The questions that need deciding are these:

1. Did Grey hit the lion at all, or once or twice—

To me it *looked* as if he missed both times but I am sure the lion had a very bloody mouth when he raised his head when I galloped up, and I hold the view that Grey missed the first shot and hit the lion in the mouth the second. I think Grey would have been dead but for that injury. I understand that Clifford Hill holds the opinion that Grey missed both shots and that the lion's bloody mouth or at least his broken jaw was done by one of my shots. I am *sure* this was not done by me or any one but Grey.

2. Did Grey dismount *before* the lion charged? or when he had started. I should have said (but am not clear about it) Grey only dismounted when the lion's charge had begun. C. Hill is positive that Grey dismounted as soon as the rear lion stopped.

3. Could he have got away on his pony when the lion charged?

I say emphatically *no* he could not even have turned his pony in the time. I do not know what else he could have done that would have been better, if he was certain of himself and confident of his power to stop a lion charge, as he said he was. Otherwise

if he had taken the charge on the pony or got off the pony so that the pony was between him and the lion, the lion might not have got at him so quickly and the pony might have got some of it, and Grey would have had a chance of killing the lion when he and the pony were brought to earth. Hill considers that if Grey had turned and galloped off *immediately* the lions stopped he would probably have got away.

4. Could we have got across to Grey when first we saw he was in danger.

Most certainly not. We did all as quick and fast as it was possible to do a thing from the moment we *realized* Grey was getting near 100 yards distant.

5. Did the lion charge *before* Hill's shot.

I cannot say whether the lion had begun his charge before the shot or whether the shot started the charge. I can say, both lions looked like charging, the rear one *was* going to charge and that I saw no possible escape for Grey unless he had the fortune to stop the lion. I never expected to see him stop the lion. C. Hill is quite clear that he (Hill) fired twice, once when the lion stopped and prepared to charge and once when he was in full charge.

6. Could any others of the party have come to the rescue or have stuck to Grey?

No certainly not, even had they known what he was going to attempt.

Slatter had a little old weak pony that could not gallop, let alone with Slatter on his back, and he pumped the pony in following and did not even get within sight of the scene.

H. Hill was on foot 2 miles away.

E. Pease was on a mule about 2 miles away.

Towards the clearing up of this incident I can give Grey's account in answer to my remarks and questions as well as what he volunteered. Here are some of his sentences: many of them he repeated.

1. Remember I say it that nobody is to blame for what has happened, that it is entirely my own fault.

2. It was *very* foolish of me.

3. I was *not* riding *directly* behind the lions but a *little to the right* of them. (H. Pease corroborates this)

4. I don't think I was as near as 100 yards when the lions stopped. I saw both the lions. (C. Hill *thought* Grey could not have *seen* them stop)

5. I did not believe that lions would charge unless shot at.

6. As soon as Hill shot I leapt off my pony.

7. I thought that after galloping the lions they would stop somewhere and that I should get a quiet shot at them.

8. (To C. Hill going to the station) "I thought I was a match for any lion but find that is not so."

I suppose from the time the charge took place to the moment when the lion was dead would be about 3 minutes, not more. We had 300 yards to gallop (Hill ran it almost as fast as we galloped, mounted and dismounted). The lion ceased to maul and savage Grey when he saw us galloping up, and lifted his great shaggy head and stared at me with his mouth wide open and all streaming with blood. At about 20 yards Howard and I had dismounted and walked in, the lion looking at us, the other lion crouching grunting and lashing his tail just beyond the one we had to kill. Hill's and my first shots were simultaneous, Hill fired another and I another, and Howard two.

To the first shots the lion responded by savaging Grey and then he bounced up and came at us and went back and lay down on Grey again and Hill's next shot knocked him out and then Hill's rifle jammed. I put the muzzle of my rifle to the right side of the lion's head and fired and he just flopped it on the ground. We thought Grey was dead. Hill called to me "the other lion is going to charge my rifle is jammed *you have got to kill him.*" I said "for God's sake don't look at him I cant stop him with my rifle" (.256)—I told Howard not to look at him. Grey said to Hill, "you want a rifle, take mine": then in a minute or two the lion moved off slowly.

A couple of days later poor, gallant George Grey died in the hospital at Nairobi. A gamer and hardier man, and a stauncher and more loyal friend never trod the African wilderness.

As we have said above we do not entirely agree with Pease about the rifles proper to use for lions. He explicitly

states that even the ten bore, reinforced by a powerful four hundred cordite, both hitting a charging lion at short range in the head, but missing the brain, failed to stop him for even a moment. Surely this shows that even the most powerful rifles may do no more than lighter ones, under the very—and only—circumstances when the big rifles are supposed to be superior. A Springfield with the pointed bullet, or a Winchester .405 with a soft-nosed bullet, could not have done any worse than the two big rifles in the above instance, and we believe they would have done better; at any rate, even at close range, they are almost, if not quite, as good as the very heavy rifles, and at all ordinary ranges are far superior. Personally we regard the mere fact of a rifle being a magazine gun as conclusively establishing its superiority over a double barrel for lion hunting, if both are good modern weapons. While we were in East Africa a Mr. Williams, a friend of Mr. McMillan, was badly bitten by a lion, because with his two barrels he slightly wounded it at a distance, and was seized before he could reload, whereas if he had been using a magazine rifle he would probably have stopped his assailant. The experiences of the two cowboys, Loveless and Means, who with Buffalo Jones roped the lioness, south of Kijabe, a few months after we were there, shows that a lion cannot catch a really good horse, already at full speed, even if it has only a few yards start. Doubtless a lion can catch an ordinary African hunting pony, which is standing or has to wheel when the lion starts, if it is under a hundred yards off. But the cow-punchers with Jones were riding big American cow horses of the best type, fast, agile, and thoroughly trained. The lioness was at bay under a bush, and the punchers kept

riding by her at a run, throwing the rope; the bush always prevented the noose going over the lioness, and she would charge at full speed (as the photos show); she was only the length of the rope behind when she started, and gained for the first fifteen or twenty yards, but never quite succeeded in catching the horse. Only the best and coolest riders, on the best horses, could have performed the feat, however. The lioness finally became cowed, crouched in a donga, and was roped, thanks to the nerve of Jones, and the extreme skill of the cowpuncher who did the actual roping.

Light, agile men who keep some distance from the lion when he is at bay can leap on their horses and ride off after shooting if the lion charges. Says Mr. Roosevelt: "Personally, I was too old and stiff to try this, and on the occasions when I was riding and dismounted to shoot at the lion, I left the horse, advanced as close as I thought the lion would stand without charging, and then trusted to straight powder, and my repeating rifle. I stopped one lion while in full charge, another as it began its charge, but while it was only trotting, and another just as, I believe, it was about to charge; and I killed a wounded lioness in tallish grass, which ought to have charged but did not, and at eight yards merely wounded a lioness, which I ought to have killed outright, but which galloped away instead of charging, so that a minute or two later I got an even closer shot, and bagged her. Thus I personally met with no adventures and neither did Kermit, although, when in company with Leslie Tarlton he one afternoon galloped a party of eleven lions and killed five, one of them, a lioness, charged with fierce determination. But since I left Africa Tarlton per-

formed an interesting feat with lions which shows what a really good hunter can do when luck is not hostile. He writes me as follows under date of June 2, 1911:

Provided you can decipher this missive, I can entertain myself by hoping that a letter from a "far countree" breathing blood and "deeds of derringdo" may take your thoughts away for a time from the sterner work of life, and recall some pleasant hours spent together, what time we carried a lioness through the darkness one night, and fondly scanned the blackness for the bellicose rhino! In a recent letter to Kermit I mentioned a rather successful hunt at Simba, and last Saturday I took a run down to a point half way between Athi and Kapiti Plains Stations, and arriving there at 3 P. M. hunted unsuccessfully for lions until dark. Next morning I was at it early, hoping to return in time for office Monday, but my hopes were considerably damped by finally seeing four lions galloping away some two miles ahead in that open country about five miles nearer Nairobi than Wami Hill where you got your first lions. I was on foot, and without much chance of a stalk in that country. I sat down and watched them until they stopped under one solitary thorn tree close to the only piece of bush within sight—about enough to really cover the four if they wanted to hide. Here they lay down, but after a long and painful stalk, the nearest I could get was 500 yards before they saw me and slid into cover—2 lions, 1 lioness and 1 large cub. Again I made a very careful stalk on the bush, and finally getting up to, beat it carefully—to find the birds flown! So I sat down and had no trouble in picking up my quarry trotting steadily away in almost perfectly flat country a mile and a half off. So the game being up apparently, I sat down under my bush and gazed through glasses at the quarry. Presently they started to walk, and the youngster lagged behind—sat down—and then went on. So we all hid under the bushes, and after half a mile of walking and stopping, the four finally came to a halt about 2 miles away, the youngster lay down, and presently went to sleep. Whereupon I set a boy on guard and followed suit. It was about 8 A. M. and a cool cloudy day and I had lots of time

COWBOYS WITH BUFFALO JONES ROPING A LIONESS

By *courtesy of Everybody's Magazine*

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THE LIONESS CHARGING THE COWBOYS AT FULL SPEED

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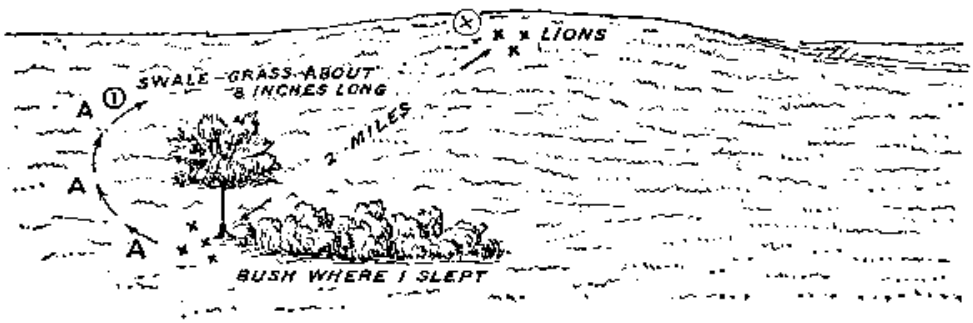
COWBOYS ROPING A LIONESS

—so although without any idea of a shot, feeling quite comfortable and lazy I thought I would try and experiment. At 10.30 the boy waked me and said they were all lying asleep—and through my glasses I saw that three out of the four were really fast asleep—only one—the lioness—lying head on paws looking our way. So I told the boy to go to sleep and took up the watch myself. Presently the lioness got up—stretched—walked 20 yards or so and again lay down—this time broadside on—and then to my joy her head gradually rolled over until she too was flat on the bare plain like a great dog. Now you can imagine that in that almost flat plain to be able to see the lions properly, when lying on their sides, two miles, not much in the way of grass obstructed the view, but a finished piece of cunning on their part eventually aided me. They had chosen for their resting place the top of a very slight rise, which commanded a view of the country all round, rather like this:—



but by going back and making a detour like arrows → A I was able to take advantage of about half a mile of longer grass, and get to point (1) before the old lioness got suspicious. Here she got up suddenly and I dropped flat and lay still for half an hour. At the end of that time as she was still on the *qui vive* (I've marked her ⊗ to distinguish her from the other sleepy ones) I took another nap, this time for an hour. At the end of that time, she was fast asleep again and then came the tug of war. Another 100 yards of my long grass (up till then about 2 feet long) and the ground was devoid of cover except for very scanty grass well-fed-down and the whole absolutely commanded by the little rise where the lions lay. By filling my hat with grass, as did my

boy—and crawling on my stomach, I began slowly to draw nearer, and the flatness of the country helped me in that the nearer I got the less advantage did the hill give the lions. Occasionally the lioness would look up but of course, we at once jammed our noses in the ground and kept stock still, and a friendly kongoni discovering them asleep distracted her attention and the sun coming out she got sleepy again and finally rolled over once and for all. Doubtless to the crocodile, the python and the puff adder, to say nothing of the subordinate government official or the baksheesh seeking gunbearers, a recumbent position may be both the natural and comfortable one for locomotion, but I grow old, rheumaticky and stiff, and what with the blazing sun, swarms of ticks, thorns, etc., etc., I should have been thankful if early in the game the lions had cleared out—as it was, begun in a spirit of pure curiosity, as the distance slowly but surely lessened between us, I felt as if the whole of my future depended upon besting them and I think if necessary I would have stayed out all night. However, the longest lane ends at last and finally I got them so beat that I rose to my knees within 80 yards of them, and having thoroughly got my breath—crawling winds me terribly—I carefully wiped the dust off my foresight, saw the other rifle-sight was clean, drew a steady bead on the biggest of the lions—and not fancying a shot at them lying flat on the ground, I "tschissted" in what I flattered myself was an exact imitation of the kongoni which had been puffing at them for so long. I did it very softly—but those sleeping lions were on their feet and saw me about one second—just one second—too long for the biggest lion who got it on the point of the shoulder as he raised himself. I gave him another which decided him to leave and then swung on to the other lion, who went head over heels to the shot, but was up and at me like a streak—whereupon his mate joined in. This was bad luck as between them they gave me so much trouble that by the time I had killed them the lioness and cub were out of range. They were two fine big fellows, but as customary with Athi lions, almost maneless. I wish Kermit could have been there—it was the most difficult interesting stalk I've ever made. I took the time and found it was just 3:30 P. M. so I think I earned my trophies.

In this letter Tarlton does not mention that the two wounded lions charged him from different quarters, coming on with savage fury; and they were stopped because Tarlton, in addition to having great coolness and nerve, is an exceptionally good shot with the rifle at dangerous game.

We do not regard marksmanship as the most important quality in the chase of dangerous game; but it is very important, and, of course, no man has a right to follow dangerous game at all unless he is a good shot, while if he is a really first-class game shot his task is very much simplified. Pease, Delamere, Tarlton, are all of them excellent shots. Stewart Edward White in his trip to East Africa in 1911, during the course of which he killed a dozen lions with his little Springfield rifle, was with our old friend and hunting companion, Cuninghame; and Cuninghame wrote us that of all the hunters, of every description, whom he had ever seen in Africa, White was the best shot. Among other noted lion hunters, Selous, Akeley, Stigand, and Rainey are all good shots. Of the above, Delamere and Stigand have been mauled by lions; Akeley was mauled by a leopard and nearly killed by an elephant. Mrs. Akeley and Mrs. McMillan—whose husband is among the successful lion hunters—have both of them killed lions to their own rifles.

Occasionally lions are killed with the rifle, as in the instance above by Tarlton, and in other instances in the careers of almost all veterans like the men named where the conditions are such as to imply high prowess on the part of the hunter and the running of grave danger. Normally, however, of course, lion hunting with a modern rifle does not mean danger of the kind incurred by coming to close quarters. Such a feat as that of Jones, Means, and Loveless

in roping the lioness implies much greater daring, skill, and risk than is normally attendant upon shooting a lion. The same is true of killing a lion with spears, after the fashion of the Masai and Nandi. In this kind of hunting, however, much depends on the type of spear. It happens that the long, very heavy, narrow spearheads of the East African cattle-owning foot-nomads are much better suited for this particular sport than the light spears of the equally fearless and gallant Zulus to the south of them and Somalis to the north of them. In Somaliland the lions subsist largely, and often mainly, on the flocks and herds of the Somalis, and frequently become man-eaters; but the Somalis only attack them under exceptional circumstances, for their spears, formidable enough against men, are too light for lions, and the danger to the lives of the hunters in the contest is very great. The Zulus also ring and kill lions with their spears, in the Nandi and Masai fashion, but their spears are, for this purpose, much inferior, and in the fight men are far more often killed and mauled than is the case in middle East Africa. We saw the Nandi spearmen kill a big-maned lion; he mauled two of their number; but a couple of days previously they had killed two lions without getting a scratch. Akeley saw ten lions thus killed and only one man was hurt. Men are rarely killed in these contests. This is because the Nandi and Masai spears are so heavy that they drive right through the lion, and into his life, from any angle; the first spear driven into the big-maned lion above mentioned entered at his left shoulder and came out through his right flank near the hip. In consequence a single spear will not infrequently kill a lion. For lighter and more agile foes the spear is too heavy and slow, and for this reason the

Nandi and Masai find the leopard more formidable than the lion in this kind of hunting. The Masai or Nandi spear is made of soft iron and is given a fine saw edge by whetting on a stone. This is a most effective cutting edge, being so sharp that it cuts its way through the toughest hide.

Among the horse-owning tribes of northern Africa there are a few in which it is customary to kill not only the lion but the elephant, rhinoceros, and buffalo from horseback with the spear or sword, some using one weapon, some the other. Of course, the spears and swords used in such hunts are not dull and blunt like ordinary cavalry sabres kept in metal scabbards; they have fine, carefully guarded points and razor edges.

Mr. Heller accompanied Paul Rainey on his African trip, in which Mr. Rainey killed several score lions with his pack of American bearhounds. Mr. Heller describes certain incidents of this trip as follows:

"The Loita Plains form a region of grassy veldt interspersed by areas of scattered acacia scrub and dotted by several high rocky kopjes which dominate the district. These kopjes being both rocky and scrub-covered are used as day retreats by the lions which have been attracted to the district by the immense herds of game which graze on the plains. The driving of one of these hills gave us the most exciting lion hunt we experienced during the entire year's safari with Paul J. Rainey.

"Six months had been spent in a neighboring district hunting lions with dogs until the pack were practically annihilated. After the loss of all the best hounds or trailers this form of sport had to be abandoned and lion driving with porters was resorted to. Leaving the Amala River

drainage we entered the Loita Plains from the west and struck across country to a high rocky kopje which dominated the whole western section of the plains. Camp was pitched on the open plains near a few muddy pools of red water some three miles from the kopje and preparations were made for beating the hill the following morning.

"The hill from camp stood out like a great headland, but at the back it sloped away gradually and connected by a wide, grassy pass with two smaller hills. The summit was strewn with huge reddish granite boulders interspersed with a few dark-green bushes. The plain at its base was everywhere grass covered and open except on the camp side toward which a scattered growth of thin bushes ran out as a long spit and connected with the bush-covered area about the water-pools near camp. The beating was done by a hundred porters who were sent in a body to the low pass behind the hill, from which point they began their operations so as to prevent the lions from breaking back to the shelter of the two smaller hills. Rainey and the hunters and photographers stationed themselves west of the hill in a slight depression of the veldt and awaited results. As we lay there waiting we saw a lioness appear on one of the huge boulders at the summit. She stood silhouetted against the sky scanning the plains for a means of escape. The noise which the beaters were now making on the lower slopes of the hill was beginning to cause the lions uneasiness. Soon other lions appeared on the rocks, sometimes as many as four appearing together and searching the horizon for the best means of escape. At intervals two magnificently maned lions appeared in sight, one with a deep black mane, his yellow head framed by a wide circle of black; the other

a yellow maned lion of equal size but less conspicuous. We could form no idea of the number of lions on the hill, but we were all wildly excited by the prospect of the numbers which had been seen. Our position was an exposed one on the open plain, past which the lions would flee only if driven by the beaters. At the eleventh hour I was sent over to the cover of the spit of scattered bushes to turn the game into the plain if it used this, the only bit of cover available. My position placed me between the lions and the camp toward which it was thought they would not attempt to flee. Several of them came out of their cover on the hilltop and surveyed me and my gun-bearers as we stood clustered about the base of a gouty little tree. These great, wily brutes were displaying a very intelligent interest in our movements, and I have no doubt but that the leaders of the troop had decided at all events not to escape by way of the open route past Rainey and his formidable array of gun-bearers and photographic assistants. When hard pressed by the beaters they left the hill in a pack, coming down the hill in close formation like a herd of sheep. They came down at a fast trot directly toward me, led by one of the lionesses. The two maned lions were the rear-guards. Rainey and his men were in action as soon as the lions had reached the plain, speeding toward them on their horses at a terrific pace. The two maned lions upon observing these hostile movements turned back into the hill and were never again seen. The rest of the troup numbering approximately sixteen, kept on their course along the spit of scattered bushes toward my position. They came past me at a swinging trot in a long line one hundred and fifty yards away. It was my duty to turn them toward the hunting

party. I took several shots at the leaders but these had no effect; in fact, they paid not the slightest heed to them but trotted past in an unbroken, unswerving line. The last of the line, however, was a lioness which displayed a threatening attitude toward me. When she got within two hundred yards she left the troop and charged me. She came in a crouching trot, growling and lashing the air with her tail. I could not understand her hostility, for only the leaders had been fired upon. I clutched the 405 Winchester and waited for her to come within range of my excited marksmanship. During this wait the gun-bearers tugged at my coat, whispering to me to shoot before the dangerous animal got any closer. At seventy yards I shot and hit her low in the chest, the shock stopping her for a second. She was up in an instant, but a second shot in the chest sent her down again. She came on again at once, growling savagely. A third shot through her leg stopped her again. Finally another shot brought her down and she lay with her head raised, growling defiance. At this juncture one of the gun-bearers excitedly called my attention to two half-grown lions which were approaching us from the rear. These were the offspring of the lioness, which had charged me because my position had accidentally placed me between her and her cubs. Rainey's two stag-hounds had attacked these youngsters which were several times the weight of the dogs, and had annoyed them so that they had lost the troop. They strayed in my direction, the dogs following and snapping at them whenever opportunity offered. After ridding myself of these two enemies by a couple of shots, I again turned my attention to the lioness and finally killed her with one of my last cartridges. Before this occurred, how-

ever, she was so broken down by the numerous body shots that she was only able to shamble along and quite incapable of doing any damage.

"The troop after passing me was overtaken by Rainey and his mounted men and six of the lions were shot. After firing had begun the danger from attack was greatly increased, owing to the number of wounded animals concealed in the scattered bushy country. The horsemen unwittingly rode quite close to some of these dangerous beasts, but escaped injury by rapid firing or retreat. Three of the fleeing lions ran through the camp and were fired upon by the askaris on guard. The morning's bag netted nine lions, three of which were large lionesses and the others maneless lions.

"An attempt was made in the afternoon to beat out the two large maned lions which had retreated to the hill. They, however, could not be found, owing without doubt to their wisdom in fleeing far away and not stopping in the vicinity of the hill from which they had been driven in the morning.

"I was greatly surprised to catch lions in steel traps set for hyenas baited with carcasses. Four lions were caught in this manner on the Rainey safari, all within the space of a few months. This very much astonished me, for I had used the same methods of trapping and the same traps for two years in the region without experiencing a single instance of the kind. The traps used are ridiculously small, the jaws being very little greater in diameter than the paw of a lion, and the weight only about six pounds. They are so small that it is only possible to catch a lion by a single toe or at most by two toes.

"The first lion caught in one of the hyena-traps showed the great holding power exerted by a single toe. Four traps were set about the carcass of a newly shot hartebeest. During the night the carcass was visited by two male lions, one of which was caught in one of the traps by the middle toe of his right hind leg. The jaws of the trap took a firm hold of the toe behind the great toe pad. To this trap was attached a drag, consisting of the limb of a thorny acacia eight feet in length and much branched. The lion, after the first struggles with the trap, dragged it a few yards to a termite hill. About this mound he rushed many times, wearing in the earth a path a foot wide. Finding this manœuvre of no avail in freeing him of his encumbrance, he proceeded some fifty yards further with the drag and climbed up the slanting trunk of a small tree which was bent over at a very oblique angle. At a point five feet above the ground the tree forked and through these forks he bounded to the ground. The trap, however, caught in the forks and held his hind foot. Here he hung, his forefeet and nose touching the ground, and the hind part of his body suspended from the tree. His plight was now irretrievable. In the morning I found him in this position with his companion some three hundred yards from him, still feeding upon the hartebeest carcass. The latter bolted upon seeing me and left his companion to his fate. The trapped lion, upon perceiving me, began to growl and thrash about in a last effort to free himself in the presence of this new danger. I prudently shot him at a distance of one hundred yards. Upon examining him I was dumfounded to find that he was caught by a single toe. He was a full-grown male, but maneless, and in excellent condition with a heavy layer of fat under his

skin. Later in the morning, after the return of Rainey with the hounds, the dogs were put upon the trail of the lion which had bolted upon our approach. But a single one of the hounds was able to follow the trail which had now been subject to three hours of sunlight. Carefully working his way along this faint scent, the hound took the pack some two miles away into a bushy ravine. Here they found his majesty and routed him out. He ran a mile and then savagely took his stand in another dense thicket. Rainey soon discovered him and waded into the bush to within forty yards of the bayed brute. As soon as an opportunity offered of shooting the lion without endangering any of the dogs, he shot him. This lion was also maneless and in fat condition, being practically the same age as the trapped specimen.

"To those who have witnessed the savage way in which a wolf attacks with its teeth and the entire strength of its body a trap which holds it by a foot, it will appear quite beyond the powers of belief to give credence to the catching of adult lions in traps of similar size as here narrated. The miracle, however, is due to the extreme caution with which the lion preserves its teeth from breakage. It refuses to risk them on hard substances like iron and will not even attempt to break heavy bones with them. When caught by a steel trap its caution is still dominant, and its rage asserts itself merely in futile tugs at the drag without any assault upon the trap or attempt at amputation of the limb by which it is held. The hyena, on the other hand, though a thoroughly cowardly beast, will attack the trap savagely, doing great injury to the crowns of its teeth, and at times as a last resort freeing itself by the amputation of the limb by which it is held.

"In order to avoid trapping more lions the traps were baited with small bits of meat which it was thought would only be attractive to hyenas or jackals. Four of the traps were set near the skinned carcasses of two small wart-hogs in a sandy ravine some four hundred yards from camp. Another trap was set close by within the mouth of a large burrow into which a few fragments of meat had been cast. During the night a party of three or four lions visited the baits and sprung the traps at the carcasses. Their tracks were perfectly preserved in the dry sand of the ravine. Finally one of the lions in investigating the burrow which had been baited was caught by one of the toes of a forepaw. After thrashing about in the sand, he made off through the dense bush growing on the sides of the ravine. In the morning on my visit to the place I found him by trailing on the hillside some two hundred yards from where the traps were set. He threatened me with deep growls and thrashed about in an effort to escape. The sun was still very low and shone directly in my eyes when I was in a position free enough from bushes to make a shot possible. I shot at him in this unfavorable light twice without much apparent effect. He then reared up on his hind legs and drew the trap up near his side. I fired again when he was in this position and then he disappeared in the bushes. He could not be seen lying dead or wounded, and we could not without foolhardy risk venture into the thicket for fear he was still there, and very angry. Luckily Rainey was near by, returning from a morning's hunt with the hounds. With the pack we entered the bush, and they at once picked up the trail. When we reached the spot where the lion had taken his stand, we found the trap broken apart, one of the

jaws having been severed by the last bullet I had fired. Within half a mile the dogs bayed him in dense brush. In order to shoot the lion, Rainey had to approach within fifteen yards. He was also a fully grown male but maneless. Upon examining his forepaws the marks of the jaws of the trap were distinctly visible on the inner toe, the congested condition of which upon skinning gave further proof of his having been caught by that member. No growling was indulged in by this lion during the night, absolute silence being maintained. The failure of this lion to charge when freed from the trap by my last shot is quite unaccountable, as he had been put to several hours of irritation.

"The next lion captured by the hyena traps was taken in a very different region. While we were camped on the lower Guaso Nyiro at the point where the Marsabit road crosses the stream, one of the mules died of tsetse infection. The country about this camp was a low, dry desert, intensely hot, having an altitude of only two thousand feet. The district was rather uniformly covered by a scattered growth of acacias and wait-a-bit thorn-bushes. The body of the mule lay half a mile away on the brush-covered plain. Near it I placed some of the steel traps for the purpose of catching striped hyenas which were abundant in the vicinity. Several days previously the mule had been guarded from the vultures and spared for lion bait, but no lions ventured near. On the night the traps were set two lions visited it, one of which was captured. This lion gave us a long trail to follow which wound about through the brush for a mile and a half, and finally into a dense reed bed of tall bulrushes much higher than our heads. My gun-bearers finally sighted the tip end of the acacia-bush drag sticking out of the reed patch. The lion had only entered the edge of the reeds, but

they were so dense that he was quite invisible to us. We stood within thirty yards making some disturbance, but no noise or sign of life came from the lion. In order to get a view into the swamp I climbed a thorn-tree growing near-by, but without the desired result. From this elevated perch I began to shoot into the reeds at about the spot I thought the lion lay, using for the purpose a small-calibre rifle. Not until the sixth shot did the lion come out, and then only because he had been hit. A more persistent case of attempt at ambush I have never witnessed. He charged out desperately in extreme ferocity, leaving us in no doubt as to what our fate would have been had we entered the reed bed. He was a terrifying sight as he stood there in his desperate rage roaring and straining to reach the fleeing gun-bearers. I placed a 405 bullet in his shoulders which sent him back into the reed bed again. In a few seconds he was out again to receive another bullet which quite took the fight out of him. He staggered back into the reed bed and died. After he had quieted down the gun-bearers cautiously pulled the drag into the bare veldt, where we could examine our late foe at our leisure. This lion was a large-bodied male, considerably older and bigger than any others we had trapped. What astonished us most was to find two traps attached to him. His forepaw was held in one trap by two toes, and his hind foot by one toe in another trap. With these encumbrances he had gone for more than a mile over rather rough veldt. Over this course he had been followed by a lioness, doubtless his mate. Her footprints were boldly marked in the smooth trail left by the trap drags. No evidence of her was found, however, in the reed beds, although the negroes asserted that she would surely remain with her mate and fight.

"An instance of the caution and intelligence of lions was observed in the circumstances surrounding the trapping of the fourth and last lion secured in such an unsportsmanlike manner. The battle-ground of this last episode was on the broad summit of Mount Lololokui. The mountain is a great table-topped mass standing isolated out in the Marsabit desert, above which it looms with quite perpendicular slopes to a height of six thousand feet. The summit is several square miles in extent and as level as the floor of the plain at its base. Two springs occur on the summit, which are the only waters known for a radius of some fifteen miles. While camped at the larger of the springs my guide told me of the existence of the other which he offered to show me. I readily accepted, and next morning we set out with the guide for the spring. It was situated in a bushy ravine, along the floor of which we approached the spot. When within a few yards of the spring we were startled by several short, growling 'whuffs.' Peering down the few open avenues in the bushes we beheld three lions scattered out in a semicircle some twenty yards away. We had awakened them from their noonday nap and they were greatly startled at our presence. The mountain being without a single human inhabitant, it was the custom of these lions to come to the spring at dawn for water and lie there most of the day and then go down to the plain below at night for their prey. After glaring at us for a few seconds, the lions retreated through the brush and were not again seen that day. Great confusion reigned among my followers; the guide nimbly mounted to the top of a large rock, my gun-bearers peered about under the bushes to locate the lions, and I brandished a shotgun. At the spring we found the footprints of the lions and also

others of bush-pigs. Specimens of the latter animals I greatly desired to add to the collection of mammals I was making, and steel traps were accordingly set that night at the spring in the hopes of catching some of the pigs. Upon approaching the spot in the morning, we heard the growls of a lion and finally made him out in the brush. He was caught by a toe of his forepaw in one of the traps, but all we could see of him was his head through an opening in the bushes. I shot him at twenty yards. He proved to be full grown, but not yet fully mature. The tracks about the spring showed that his two companions had been to the water with him. They, however, never again returned during the fortnight we remained there. A single instance of capture by trapping was sufficient to cause these cautious animals to avoid the locality and seek other water several miles away."

KEY TO THE RACES OF *leo*

Body color buffy or olive-buff; mane long-haired, yellow, black usually only at tips on shoulders or along midline of nape; teeth larger; female tawny, sides of belly and inside of legs marked by pale, indefinite darker spots *massaica*

Body color of male tawny or ochraceous; mane short-haired, tawny, black or dark only on shoulders and nape; teeth smaller *nyanzæ*

EAST AFRICAN LION

Felis leo massaica

NATIVE NAMES: Swahili, *simba;* Kikamba, *mwenyambo;* Kikuyu, *ngatia;* Masai, *ol ngatuny.*

Felis leo massaicus Neumann, 1900, Zool. Jahrb., XIII, p. 550.

RANGE.—The whole of British East Africa northward through the Uganda highlands east of the Nile and the

Rift Valley of Abyssinia, south through German East Africa, and west as far as the Tanganyika drainage.

The lion is universally distributed throughout eastern Africa from the coast inland to the high plateaux, and is wanting only in the dense forests and absolutely waterless desert tracts. Almost a century ago an Austrian naturalist, von Meyer, published in Vienna descriptions of the Barbary, Senegal, and Persian races of the lion which were in vogue for a time. These names have remained long in obscurity, however, and have only recently been brought to light by Hollister.* Naturalists are now convinced that the lion shows definite geographical variation which is constant enough to warrant the recognition of many of the described races. In 1900 Oscar Neumann named the East African race, *massaica*, basing his description upon the skin of an adult male which he had obtained in Kibaya, south of Kilimanjaro, in German East Africa. Some years later Lönnberg renamed the same race *sabakiensis*, from specimens collected on the lower slopes of Kilimanjaro.

The East African race may be known by its light-buffy color, yellow mane, large body size, narrow skull, and the small size of the cheek teeth. The body color ranges from an ochraceous-buff to an olive-buff, often showing a distinct gray cast. The mane usually shows black hair along the nape and throughout its posterior border on the shoulders. Occasional specimens are found in which the whole mane is black with the exception of the fore part on the throat and sides of the head. Of the large series of specimens from British East Africa in the National Museum there is not one which can be classed as black-maned. A specimen killed by Carl E. Akeley, on the Mau summit, at 9,000 feet, near the station of Molo, has the greatest amount of black in the mane of any specimen examined. The dark extremes are seldom met, however, the usual coloration being a light buff, lined dorsally by black-tipped hairs, with a mane showing black-tipped hair only on nape and shoulders. One of the color characters often assigned to this race is the spotted sides in the adult. An examination of a large series of old or fully adult male skins, how-

* Proc. Biol. Soc., Wash., 1910, p. 123.

ever, showed the sides unspotted, but the adult females and the young show darker spots on the sides of the belly and inside of legs of an indefinite sort which are only evident on close inspection. The spots are large blotches of ochraceous color and show very little contrast to the buffy or whitish ground-color. The lioness is decidedly darker than the lion, the body color being tawny and only exceptionally as light as the buff or olive-buff of the lion. The lioness of the South African and Abyssinian races is quite identical in tint of color to the lion. The former, however, is not spotted on the sides of the belly. The lioness of the Abyssinian race shows spots on the sides of the belly and inside of the legs similar to those of *massaica*, with which they also agree closely in the tawny body coloration. The nearest geographical ally of the East African is the desert race from Somaliland, from which it is doubtfully distinct. The coloration is quite identical in the two forms, but the mane is apparently shorter, the body size less, and the cheek teeth smaller in the Somali race. The characters assigned by Noack in the original description of *Felis leo somaliensis*, of larger ears and longer tail, are not applicable to the race, these parts having the same proportionate size as in other members of the group. Noack's description was based on a pair living at the Berlin Zoological Gardens, and the characters he assigned to the race are merely such as appeared upon casual observation and are not founded upon actual measurements of specimens. Doctor Matschie has informed us that the types have been exchanged by the Berlin Zoological Gardens to animal traders, and their present abode is unknown. The unfortunate condition of these types is a good illustration of the loss and confusion to systematic work so often attendant upon the pernicious custom of naming species from living specimens. In the present case we have no exact characters and no knowledge of the skull structure of the race described as *somaliensis*, merely a few casual observations to which are attached a general locality of doubtful value. Several of the types of African big-game mammals are today living in various zoological gardens. Special efforts should be made by such institutions to keep trace of these types, and upon their death deposit the specimens in the

largest available public museum where they can be preserved and accessible to zoologists for comparison.

Adult lions vary surprisingly little in size, as evidenced by the slight variation in skull dimensions. The extreme skull lengths show a difference of only one inch in a series of fifteen old adult males in the National Museum from British East Africa. The size variation in the lioness is greater, the extremes being 1⅞ inches apart in a series of twenty old skulls from the same general locality. The largest male skulls in the National Museum are quite identical in greatest length. The very largest is one killed by Paul J. Rainey, which has a length of 14 11/16 inches, the next in size being one shot by Colonel Roosevelt, measuring only 1/16 inch less in length. An average skull length for an adult male is 14⅛ inches. The smallest old male has a skull length of 13¾ inches. The skulls of adult lionesses range in greatest length from 12⅜ inches to 11 inches. It is doubtful if skulls from East Africa ever equal 15 inches in length, notwithstanding Ward records several exceeding this dimension. The largest known skull in length is one now in the Berlin Museum, which represents a South African specimen which lived formerly in the Transvaal Zoological Gardens near Delagoa Bay. The length of this skull, as measured by Heller, is 16 1/16 inches. Ward records this skull also as the longest, but overstates its length, giving it as 17 inches. The greatest or zygomatic width of this skull is 10 11/16 inches. A skull in the National Museum, known as the Richardson lion, formerly living in the Central Park Zoo of New York City, exceeds that width by 1/16 of an inch and is the record specimen in this dimension. Much stress has been laid upon the skull dimensions owing to their importance in determining the actual relative size of specimens. Sportsmen often attach great weight to flesh measurements, consisting usually of the total length from nose to tip of tail and the height from the pad of the forefoot to the withers. Such measurements, however, are subject to much personal variation, no two sportsmen taking the measurements quite alike. Measurements taken of bone lengths, such as the skull, show the relative size of specimens much more accurately. The largest adult male lion shot by Colonel Roosevelt was a specimen from the Loita

Plains and had the following flesh measurements: head and body, 77 inches; tail, 40 inches; hind foot, 15 inches; ear, 6⅛ inches; weight, 412 pounds. The average specimen is somewhat less than these dimensions. An average female specimen measured in the flesh: head and body, 62 inches; tail, 38 inches; hind foot, 12¾ inches; ear, 4¾ inches.

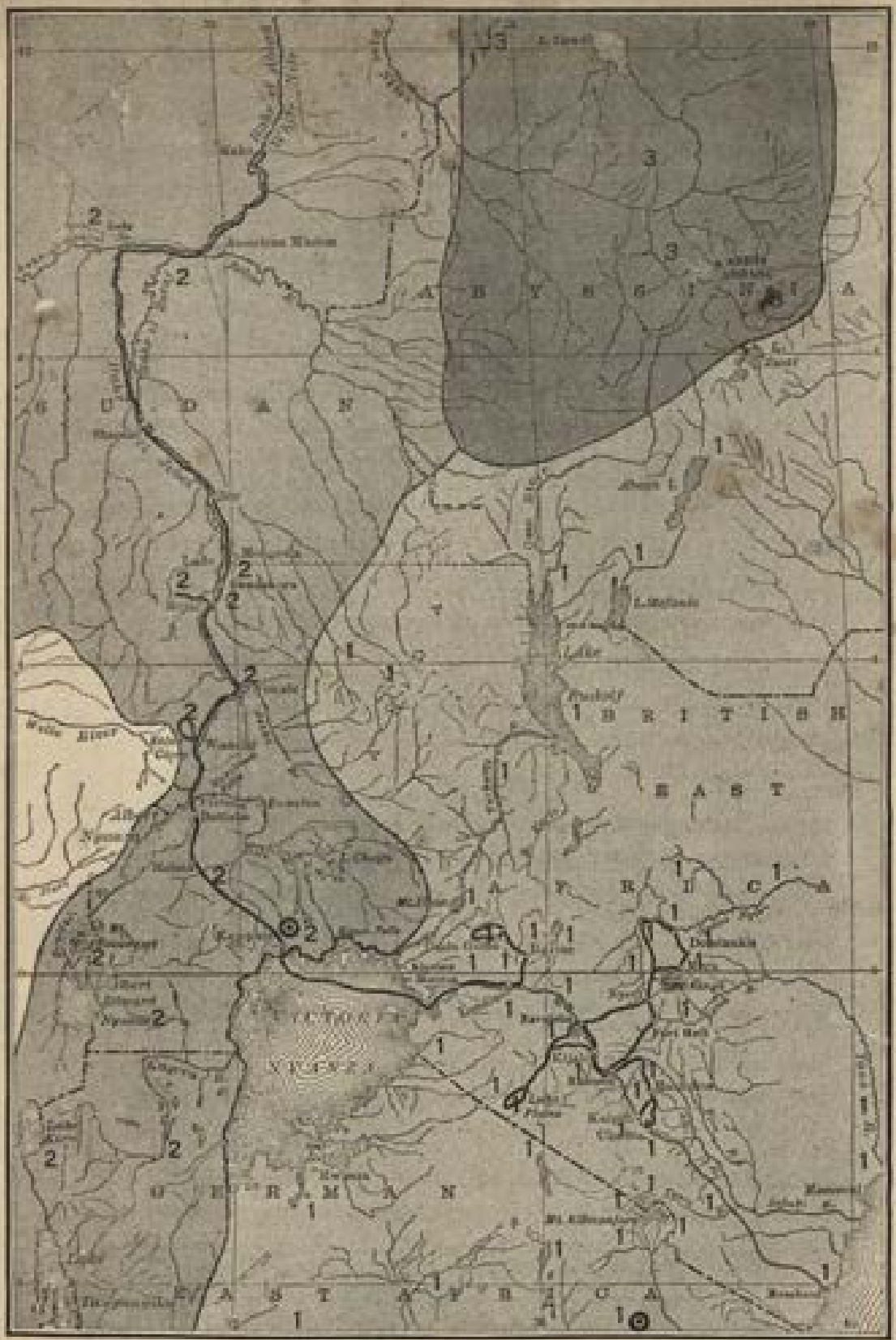
Uganda Lion

Felis leo nyanzæ

Native Names: Uganda, *empologoma;* Bari, *kamiru;* Unyoro, *linani.*
Felis leo nyanzæ Heller, 1913, Smith. Misc. Coll., vol. 61, No. 19, p. 4.

Range.—Uganda and the Nile Valley from the German border northward to the Sobat and the Bahr-el-Ghazal drainages, east as far as Mount Elgon and the western shore of the Victoria Nyanza, and west to the Congo-Nile watershed; limits of range unknown.

The Uganda race of the lion has been recently described by Heller from a flat skin from Kampala presented to Colonel Roosevelt by the European residents. From the East African lion it may be distinguished by its darker coloration and shorter mane. The dorsal color is tawny and quite identical in tone to that of the Abyssinian, but the mane is light-colored with little or no blackish cast and short-haired. It differs further from the Abyssinian race by its narrow skull, relatively shorter cheek teeth, and narrow mesopterygoid fossa. The Uganda race does not apparently share the close approximation to its West African representative that is exhibited by much of the mammal fauna of the region. The broad-skulled, large-toothed race *senegalensis* of West Africa is strikingly different from the narrow-skulled, small-toothed *nyanzæ*. The coloration of the type skin is ochraceous-tawny, vermiculated very slightly with black over the median line of the back. The sides of the body are ochraceous without darker spots and the belly is somewhat lighter, being buffy-ochraceous. The mane is short and does not extend over the shoulders except on the median line of the withers, where it forms a narrow ridge of hair 2 inches wide by 10 inches long. In color the mane is tawny with a seal-brownish patch on the nape and



MAP 9—DISTRIBUTION OF THE RACES OF THE LION

1 *Felis leo massaica* 2 *Felis leo nyanza* 3 *Felis leo roosevelti*

The numerals **1, 2, 3,** etc., on the map mark the exact spots where specimens have been collected or observed by reputable sportsmen, and the lines limiting the distribution are drawn around these numerals so as to map the approximate area occupied by the race to which the numeral refers.

⊙ Represents type locality or exact spot from which the type or original specimen came.

The heavy black line on this & the following maps indicates the route of Col. Roosevelt's African expedition of 1909-10.

another at the terminal tip of the narrow stripe on the withers. The length of the hair on the nape is only 3 inches. The legs are tawny like the back in color on the outside, buffy on the inside, with the hair on the under side of the toes seal-brown. The head is like the back in color, with somewhat stronger black vermiculation, and the ears have the black spot on the back narrow.

Four complete specimens of this race from Uganda have been examined at the British Museum, consisting of a lion and two lionesses from Mulema and one lioness from Ankole. The skin of the lion has a small tawny mane quite similar to the flat skin from Kampala. The lionesses are tawny in color, similar to the lion. The skull of the lion has a length of $14\frac{1}{16}$ inches and a breadth of $9\frac{1}{16}$ inches. The three lionesses range in skull length from $11\frac{5}{8}$ inches to $12\frac{1}{8}$ inches and in breadth from $7\frac{1}{2}$ inches to 8 inches. In the absence of flesh measurements of specimens the dimensions of the flat skin from Kampala may be taken as showing approximately the size of the race, the measurements of which are: head and body, 75 inches; tail, 35 inches; ear, 4 inches.

CHAPTER VII

THE LEOPARD AND THE CHEETAH

The Leopard

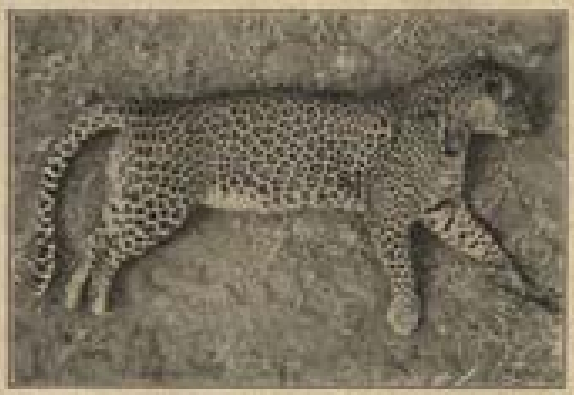
Felis pardus

The leopard is widely distributed from China, India, and the islands of Japan and Java westward through Persia to Asia Minor, Arabia, and the whole of Africa. It is over this territory a universally distributed animal, being found in all the forest and bush country as well as in sheltered nooks on the plains. The leopard still occurs over practically all its original range, being able to hold its own against man owing to its stealthy habits. Externally the leopard may be distinguished from the other species of large cats by the small size and rosette-like character of its dark spots. Several well-marked races of leopards are recognizable, but the Indian races as a whole are not distinguishable from the African, there being apparently no characters of continental scope in the group. Skins from Java, for instance, are not distinguishable in coloration from the Soudan leopard, or typical *pardus*. Chinese specimens may, as a rule, be recognized by the distinctness of the black median stripe formed by a series of closely linked, elongate, solid black spots, while others from Central Asia exhibit large rosettes or ocellations widely separated by the ground-color, somewhat after the

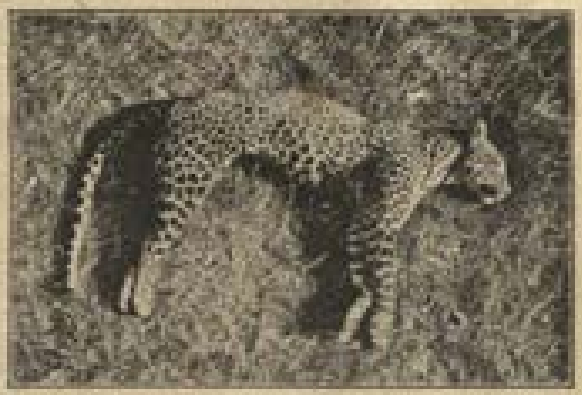
style of the snow-leopard. The African races may all be considered small-spotted, although they show racial differences in the degree of smallness of the spots. Indian leopards are comparatively uniform in size compared with the African, the largest races of which exceed any Indian, while the diminutive *nanopardus* of Somaliland represents the smallest of all known races. The African races number some eight or ten forms, which are distinguishable by differences in body size, skull shape, arrangement of spots, and general coloration. In Africa the leopard occurs everywhere, except in waterless desert tracts, from the seacoast to the limits of vegetation on the highest mountains. It is rare, however, in the depth of the forest and in the alpine zone of the high mountains. About the forest edges and in bush country it is most abundant. The sexes differ much in size, the males usually showing an excess of forty pounds over females. There are, however, no differences in color, but female skulls may be recognized, aside from the difference in size, by the relatively much smaller size of the canine and carnassial teeth. The young are much more finely spotted than the adults, owing to the spots which later coalesce and form the rosettes being widely separated and appearing as distinct solid spots, no rosette formation being evident. This broken condition of the ocellations, or rosettes, remains until the animal is of large size, and has given rise among some hunters or sportsmen to the belief in the existence of two species inhabiting the same locality, a fine-spotted and a large-spotted form.

Save where it has been killed out, the leopard is found all over Africa, as well as in southern Asia. From the standpoint of animal coloration it is interesting to compare the distri-

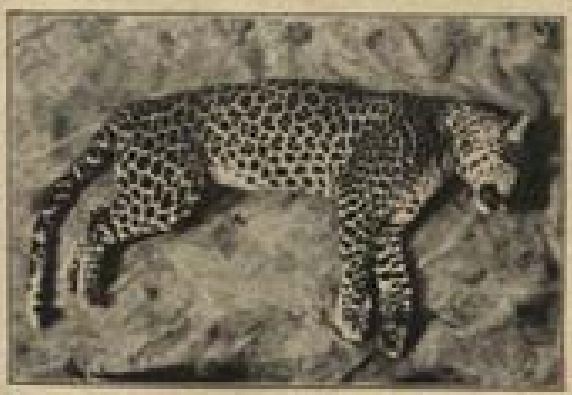
FOREST LEOPARD, MALE
Man-eater trapped by Edmund Heller on body of an elephant at Meru, Mt. Kenia, B. E. A.
United States National Museum



EAST AFRICAN LEOPARD, ADULT MALE
Lake Naivasha



EAST AFRICAN LEOPARD, ADULT FEMALE
Shot by Kermit Roosevelt, Nzoia River



FOREST LEOPARD, ADULT MALE
Meru, Mt. Kenia

NILE LEOPARD, ADULT MALE
Gondokoro, Uganda

RACES OF THE LEOPARD

bution of the mono-colored lion and spotted leopard of the Old World with that of the mono-colored puma and spotted jaguar in the New World. The facts in the two cases are mutually contradictory if the effort is made to build theories of concealing coloration on them. In America the big spotted cat has a range restricted to the dense tropical and subtropical forest regions; while the mono-colored cat has a far more extensive range, being found in the north and south temperate zones, and in the high mountains and on the open plains, as well as among the forests in which the jaguar dwells. In Africa the spotted cat is found almost everywhere that the lion goes, while the latter never ventures into the dense forests which are favorite haunts of the former. The lion is not only absent from the vast equatorial forests of West Africa in which the leopard dwells, but also from the isolated forest tracts of East Africa, which are also haunted by the leopard. On the other hand, the leopard is found in most of the country wherein the lion lives. Along the Guaso Nyiro, in the Uasin Gishu, and on the Athi Plains, for instance, and in the Sotik and the Lado, we found the lion and leopard in precisely the same country. In this open country of grass and thorn-scrub each was extraordinarily difficult to make out when it was hiding or even when merely lying motionless; and in thick cover they were also extremely and equally difficult to see. We could not find out that the color of the coat had any effect in making one more conspicuous than the other. This was true when they were lying, as they ordinarily were, in exactly the same cover.

The wide distribution of the leopard in altitude and latitude, its ability to lie concealed alike in the thorn-scrub

and in heavy timber, its lithe activity, stealth, and cunning, its ferocious daring and extreme wariness and caution, make it as universally known as it is rarely seen. It preys on the smaller antelopes and the young of the larger antelopes and zebras; also on birds and small mammals. It is fond of the wild swine, but avoids the old boars. It is the especial enemy of the baboons, which are always on the watch for it. A female or young baboon is helpless against its assault, but an old male, unless seized in the first rush in such fashion that it cannot retaliate, will put up a good fight, for its teeth are as formidable as the leopard's. The weight and claws of the leopard, however, give it the advantage over even a male baboon of the ordinary kinds (the hideous mandrill of the western forests may stand in another category). But if the horde is large and contains a number of full-grown males the latter may combine for the rescue, and in their turn assail the assailant. Baboons are fearsome beasts under such conditions; the father of one of the 'Ndorobo who was with us when after bongo had been killed by baboons which rallied to the aid of one of their number that the man was trying to kill with his knobkerry. They frequently drive off leopards and have been known to kill them. Lord Delamere came across one such instance. A leopard attacked some baboons among the rocks, and a tremendous row ensued as the old dog baboons drove the leopard from the animal that had been seized. That evening the same leopard, very thin and hungry, came into camp and was shot; it was already fatally wounded, the bites it had received being such as only baboons inflict. There have been authentic cases of leopards being killed by old boars and by old male bushbuck. Save in exceptional

instances a leopard does not attack animals bigger than a half-grown waterbuck, hartebeest or zebra. Unlike wolves and dogs, which usually snap at the flanks and hams of their prey, the leopard, like the lion, tiger, jaguar, and puma, ordinarily kills by bites in the head, neck, or throat. It will kill a serval or jackal, and is itself, although very rarely, killed by the lion and crocodile; and it has been known to go up a tree to avoid wild dogs. With the hyenas it lives in a state of partial feud. Neither preys on the other, unless that other is sick or crippled; and a single hyena dares not meddle with a leopard. But two or three will attack a leopard and drive it from its just killed prey. Sir Alfred Pease once saw a leopard leap over the thorn fence surrounding a Somali encampment, seize a sheep, and leap back with it over the fence, only to be at once robbed of its booty by the hyenas outside, which cackled, yelled, and laughed like so many ghouls as they devoured the spoil they had stolen from the stealer. It is undoubtedly because of the hyenas that the leopard is so apt to hang its prey in the branches of a tree. The strength shown in carrying the prey up the tree is astonishing. Once on the Guaso Nyiro we found half the carcass of a big Grévy zebra colt which had thus been dragged into a thorn-tree. The attack is always made by a sudden rush from ambush on the surprised quarry; occasionally the leopard lies in wait, but more often it prowls about and stalks its quarry when seen or scented, the approach being a marvel of slinking and noiseless stealth.

The leopard is a bold marauder against man, killing the calves, goats, sheep, pigs, dogs, and chickens of any village which it visits, and sometimes breaking into the building

in which they are secured. It will also occasionally take to man eating. Twice we came across instances of this in East Africa. In each case the offender was a big male leopard, so old that its teeth were worn down; evidently it had begun to find it difficult to kill game, and so took for its quarry the females and young of the most helpless of animals, man. Both of them made their assaults by day. One took to killing the small boys that minded the herds of goats; sometimes he took a boy, sometimes a goat. He was killed by two old men with spears, on the last occasion when he thus sought to carry off a boy. The other, shortly before our arrival at Meru, had begun a career of woman killing. He strangled and ate one woman, and seized and mauled another, but was driven off. We caught him in a trap. Both of these leopards killed to eat. But on another occasion a leopard attacked a man in a fit of freakish ferocity. A Masai chief, with some followers, was sitting under a tree at noon, when a leopard, without warning, sprang on him, clawed him severely, but did not bite him, and then escaped.

Like other cats, the leopard is sensitive to pain, and is easily held by even a small trap. Nor does it, like a wolf or hyena, tend to splinter its teeth by biting the iron. On several occasions we caught leopards in steel traps such as those used in America for coons and foxes. In two or three cases the leopard was caught by only one toe, and went off with the trap and drag—the drag being a fairly large branch. As soon as it knew it was followed it charged ferociously, although much hampered by the trap and drag, and was shot while charging. It was in each case firmly held by the single toe.

On the whole, the leopard is the fiercest and pluckiest of African game. It charges as freely as the lion, and is so quick and agile, and offers so small a mark, that it is harder to hit. A bullet stops it more easily, however, and in strength and size it is so inferior to a lion that its assault is much less likely to be fatal. Kermit was fiercely charged by an unwounded leopard, which, after he had crippled and mortally wounded it, caught and mauled a native. Yet it weighed less than seventy pounds. The biggest males we got weighed about one hundred and thirty pounds. Carl Akeley was bitten and clawed by a leopard he had wounded; he killed it with his naked hands, partly by choking, partly by crushing its breast with his knees—an extraordinary feat. Many hunters have been wounded, and a few have been killed, by leopards. It is incomparably fiercer, pluckier, and more dangerous to man than the cougar, although the latter in some of its forms is larger and has longer teeth and claws. Yet the leopard does not attack and master more formidable game than the cougar. A good pack of hounds will kill it as readily as they will kill a cougar. Paul Rainey, in the course of his lion hunting, killed several leopards. Four of these, all full grown, the pack finished without assistance. They could always kill a leopard if they got it in open ground; but among dense bushes or rocks it was generally able to stand them off, as they could only get at it in front. Two or three big fighting dogs will kill a leopard without especial difficulty.

KEY TO THE RACES OF *pardus*

Body size smaller, skull length in males less than 9½ inches; ground-color on back lighter than cinnamon-brown; rosettes often forming ocellated or completely ringed spots

Spots numerous and crowded, the interspaces of light ground-color narrow; ground-color of hind feet ochraceous, like the flanks; ventral surface of tail tip with a narrow whitish stripe

Spots smaller on back and more widely separated *suahelica*

Spots larger on back, the interspaces forming narrow reticulations, the predominating color being the black of the rosettes, or ocellations *ruwenzorii*

Spots fewer, large and widely separated by the light ground-color which is the predominating color; ground-color of hind feet white; ventral surface of tail with a broad white stripe *chui*

Body size larger, skull length exceeding 9½ inches in males; coloration dark, ground-color cinnamon-brown, spots on back small and broken, not distinctly ocellated, and with central portion not darker than ground-color *fortis*

EAST AFRICAN LEOPARD

Felis pardus suahelica

NATIVE NAMES: Swahili, *chui;* Kikamba, *ngo;* Kikuyu, *ngari;* Masai, *ol owarukeri.*

Felis leopardus suahelicus Neumann, 1900, Zool. Jahrb., XIII, p. 551.

RANGE.—British and German East Africa, from the coast districts westward through Uganda to the Edward Nyanza and Lake Kivu, north to Abyssinia and western Somaliland.

The East African race of the leopard was described in 1900 by Herr Oscar Neumann from some flat skins which he obtained in German East Africa during his journey in 1893. Unfortunately, however, his description is very meagre, the name referring merely to what he called the large-spotted leopard without being based on any par-

ticular specimen or locality. Reference to his specimens now in the Berlin Museum shows none marked as the type, so that an exact idea of what he had in mind cannot now be ascertained. He mentions obtaining specimens at Tanga, Lake Manyara, Nai, and Usandawe, German East Africa, and also Uganda. Neumann labored under the supposition that two species occurred throughout East Africa, a large-spotted and a small-spotted form, the former of which he attempted to describe as *suahelica*. No substantial difference in the size of the spots in adults from the region can be detected. There is, however, a marked difference in spotting in the immature and the adults, the former being fine-spotted, owing to the rosettes being broken up into several solid spots which later coalesce to form the rosettes of the adult. Neumann's skins were chiefly flat specimens obtained from natives and were without skulls, so that their relative ages were unknown, and the error of associating the difference in size of spots with racial rather than age characters was doubtless made. Old males often show the larger and more completely ocellated spots.

The characters of the East African race are the small size and great number of the black spots, which are rosette-like in formation, being made up of three or four coalesced spots into a circular form. The ring, however, is seldom complete or ocellated in character, but the light central portion or eye is usually distinctly darker in shade than the general ground-color. The general dorsal ground-color is usually light, ochraceous, or olive-buff in shade, paling below to pure white on under-parts and the inside of the legs. The body is of medium size, with a relatively broad head or skull, and small cheek teeth.

The East African leopard occurs almost everywhere throughout its range except in the low, waterless desert tracts between the Sabaki and Tana Rivers and in the Galla or Abyssinian desert, north of the latter river. It occurs everywhere in the desert in the close proximity of springs, being absent only where water is absolutely wanting. Specimens have been examined in the National Museum from the Kapiti and Athi Plains, Naivasha, Loita Plains, Kisi Province, Uasin Gishu Plateau, Nakuru, and Voi, British East Africa. The leopard ranges to a high alti-

tude on Kenia and the Aberdare Range, ascending to the alpine meadows which lie at 10,000 to 13,000 feet. The tracks were not infrequently seen at such altitudes, which would indicate the residence of the animal and not merely its occasional straying into the alpine region. Such resident mountain-dwelling individuals had best perhaps be referred to the next race rather than to this plains-and-bush animal.

The flesh measurements of the largest male specimen, one obtained at Lake Naivasha by Heller, were: head and body, 50 inches; tail, 35 inches; hind foot, 10½ inches; ear, 3⅜ inches. The skull of this specimen measured 9¼ inches in greatest length by 5 1/16 inches in greatest, or zygomatic, breadth. A man-eating male leopard caught at Meru Station on the northern slopes of Mount Kenia agreed very closely in size with this specimen, being but little less in dimensions. The large carnassial cheek teeth, which perform most of the work of cutting up the food before swallowing, were decayed and their crowns broken down to the level of the gums in this specimen, which may have had some influence on his abnormal habits. Adult males, as a rule, vary little in size, but the females show much greater size variation. The female specimen shot by Kermit Roosevelt at Juja Farm, which showed such ferocity and attacked him without hesitation when wounded, has the smallest skull of any specimen and was really diminutive in body size, the skull being 1⅛ inches less in length than the largest female specimen. The flesh measurements of this female were: head and body, 39½ inches; tail, 28¾ inches; hind foot, 8¾ inches; ear, 2⅝ inches. A large female from the Uasin Gishu Plateau is much larger, and measured in the flesh: head and body, 48 inches; tail, 33 inches; hind foot, 9 inches; and ear, 3 inches.

Forest Leopard

Felis pardus ruwenzorii

Native Name: Luganda, *engo*.

Felis pardus ruwenzorii Camerano, 1906, Boll. Mus. Zool., Torino, XVI, No. 343, p. 1.

Range.—Ruwenzori and Mount Kenia forest region, ascending to high altitudes; limits of range not known.

The Ruwenzori leopard is based on a specimen obtained by the expedition to Ruwenzori, led by the Duke of the Abruzzi, in 1906. The specimen was secured at a high altitude, eleven thousand five hundred feet, and doubtless represents a mountain race confined to the higher parts of Kenia and the Ruwenzori Range. The photograph of the mounted specimen published in the scientific results of the Abruzzi expedition shows a large spotted type of coloration, the dorsal rosettes being separated by narrow reticulations of light color and having the central or eye portion of the spot small, the black ring being much wider than in the East African race, causing the black color to predominate. The tail is chiefly black with a few light reticulations on the basal part. The man-eating specimen already referred to from the Kenia forest at Meru, and now mounted in the National Museum, resembles *ruwenzorii* more closely than any other specimen in the collection. It shows strong evidence of the same large spots and reticulated ground-color, but the eyes of the rosettes have the appearance of being larger than in *ruwenzorii*, giving a less blackish tone to the general color. The two specimens have the same bodily size, judging by the skulls which are quite identical in dimensions. The similarity in coloration is due doubtless to the similarity in environment, both being forest-dwelling mountain inhabitants.

Nile Leopard

Felis pardus chui

Native Names: Bari, *koka;* Acholi, *kwat;* Aluru, *kwats.*
Felis pardus chui Heller, 1913, Smith. Misc. Coll., vol. 61, No. 19, p. 6.

Range.—Lowlands of the Nile from the Albert Nyanza northward to the Sobat and Bahr-el-Ghazal River systems; limits of range unknown.

The Nile leopard is distinguishable from the East African by the fewer number of spots, the wider interspaces between them, the greater extension of the white ground-color of the under-parts to the upper surface of the hind feet, and the ventral surface of the tip of the tail, the larger body size, and larger skull. There is a tendency in

the spots to become completely ringed or ocellated. Quite a number of such occur scattered over the dorsal surface among the more numerous rosetted spots. The West African race of the leopard, *leopardus*, differs by having actually as well as relatively larger cheek teeth, more numerous spots, and smaller body size. The leopard of upper Egypt, which should stand as the typical race, instead of the Indian, according to Oldfield Thomas, is a smaller-spotted race than *chui*, with a bright ochraceous-tawny dorsal ground-color. The type specimen was caught at Gondokoro by Heller, who also secured another at Rhino Camp, on the west bank of the Nile. The dorsal body color is ochraceous, paling on the sides to buffy and on the belly and the under-parts of the legs to pure white. The spots are black-rosetted, the centre being usually darker-ochraceous than the ground-color and the margin in some forming a complete ring without any breaks, being distinctly ocellated in character. The spots on the under side of the body and on the legs are generally solid black without lighter central portion. The spots on the head and the sides of the face are broken up into numerous small blotches. The tail is marked basally with rosetted spots which become lengthened into solid streaks on the middle portion and terminally have a ringed appearance with much white from the under side showing on the sides and nearly separating the black rings of the extreme tip.

The measurements of the type in the flesh were: head and body, 49 inches; tail, 33 inches; hind foot, 10 inches; ear, 3½ inches; skull, greatest length, 9 9/16 inches; breadth, 5⅞ inches. The Rhino Camp specimen exceeds the type somewhat in size, which would indicate a really large average size for the race. Rowland Ward records an exceptionally large leopard skull taken in the White Nile region by the game warden of the Soudan, A. L. Butler, measuring 10¼ inches, which doubtless represents this race. Judging by the dimensions of this skull, the Nile leopard is an animal quite equal in size to *fortis*, the highland leopard of British East Africa.

Highland Leopard

Felis pardus fortis

Felis pardus fortis Heller, 1913, Smith. Misc. Coll., vol. 61, No. 19, p. 5.

Range.—Mau highlands of British East Africa; limits of range unknown.

The highland leopard is a large race, which attains the maximum size, the skull exceeding in length that of any other African or Asiatic race. The skull is further distinguishable by its narrowness, the small size of the tympanic bullæ, and the absence of the first upper premolar tooth. The body size is large, with long pelage, dark coloration, and numerous small, rosetted spots, the central color of which is not differentiated in shade from the general ground-color. *Fortis* resembles in color *suahelica* most, but is easily distinguishable by the darker ground-color, which is uniform in shade with the central portion of the rosetted spots. Male skulls of *suahelica* differ by their smaller size, the largest being seven-eighths of an inch less in length than the type of *fortis*, decidedly larger bullæ, and by the presence of a well-developed first upper premolar. The bullæ in *fortis* do not rise to the level of the mastoid process, the skull when placed on a level resting upon the bullæ; but in *suahelica* they extend well beyond the tips of the mastoid.

The ground-color of the type on the median line of the back is cinnamon-brown, paling on the sides to ochraceous-tawny, and on the under-parts and inside of limbs to whitish or pale buff. The rosetted spots on the back are small and broken into two or three sections, the central portion being uniform in color with the cinnamon-brown ground-color. On the sides of the body the central portion is darker than the ground-color, as usual among leopards. The under-parts, legs, head, and basal part of the tail are marked by solid black spots, the terminal portion of the tail being solid blackish with a narrow median whitish band on the under side. Ears tawny, like the ground-color of the head, and marked by a broad band of black across the middle of the back.

The type is without flesh measurements, but the skull

indicates a very large race, almost equalling a lioness in size, and measures, greatest length, 10¼ inches; greatest breadth, 9 5/16 inches. No other specimen closely approximating the type in size and skull characters has been detected in the collections of the United States National, British, or Berlin Museums. We may possibly be dealing here with an abnormal or freak specimen, but the limits of the individual variation in leopards, as shown by the large series examined, show that this specimen is well beyond such limits in its peculiarities.

The Cheetah

Acinonyx

Acinonyx Brookes, 1828, Cat. Anat. and Zool. Mus., Joshua Brookes, London, p. 33; type *A. venaticus* of India.

The cheetah is strikingly like a greyhound in body form as well as in its non-retractile claws. It is the only living member of the cat family that has succeeded in breaking away from the typical cat type. Although the long, slender racing body and canine claws give it conspicuous external characters, the skull shows no less marked peculiarity compared to that of the true cats. The skull is extremely high and dome-shaped, with a much shorter jaw than any of the cats, and is furnished with short canines and very narrow carnassial teeth which have lost the large inner cusps so conspicuous in cats and consequently the crushing power of the teeth is less. The skull of the lynx approaches more closely that of the cheetah than any other of the cats, but it is more distinctly elongate and decidedly lower or less dome-shaped, with typically feline teeth. The houndlike form of the cheetah has been brought about by similarity of habit and is not in any way due to closer blood-relationship with the *Canidæ*, for the cheetah is much more widely removed by its skull structure from dogs than such typical cats as the lion and the leopard. The cheetah may be taken as an excellent illustration of the effect of habit on body form. In general style of coloration the cheetah resembles the serval cat, with which it shares much of its territory. Both are marked uniformly by solid black spots

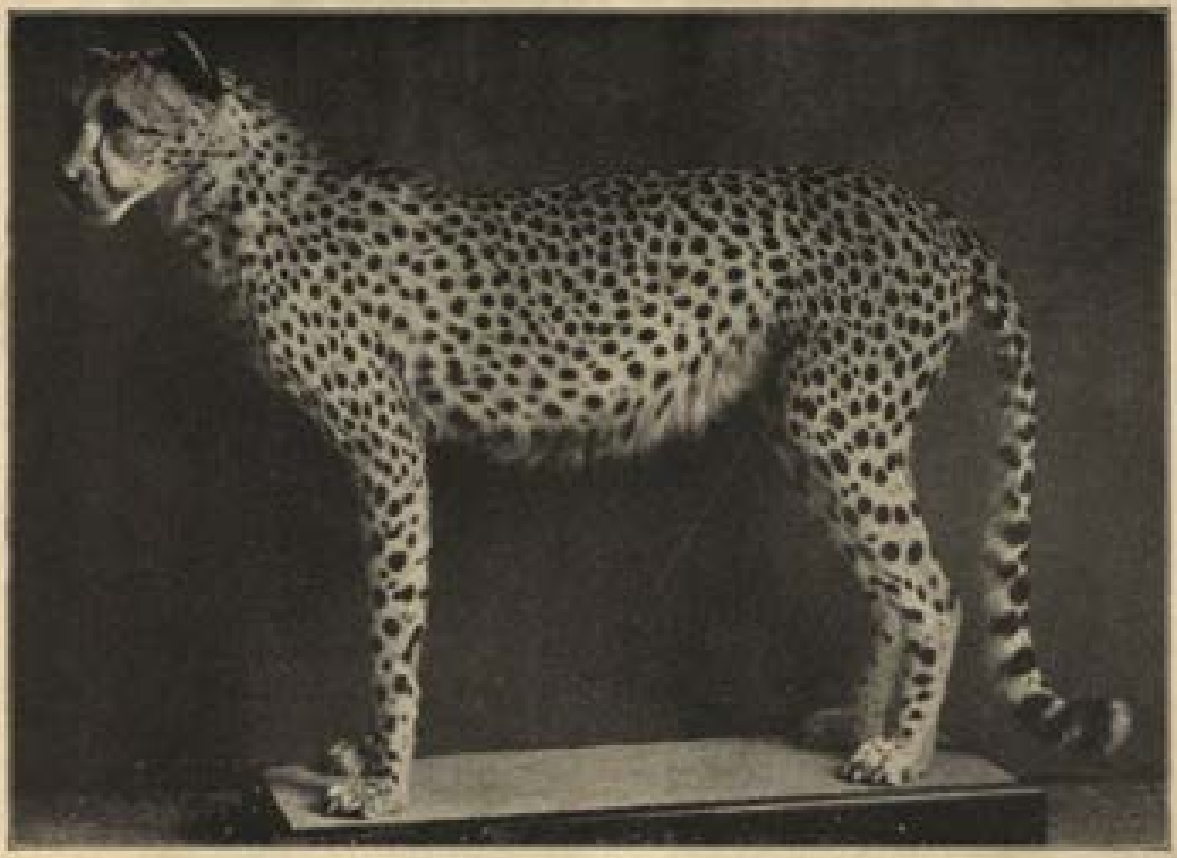
which show no tendency to form rosettes, ocellated spots, cross-bands, or stripes. The female is slightly smaller than the male, the sexual discrepancy in size being much less than in the true cats. No color differences are apparent between the sexes. Newly born young have long, woolly hair and show little evidence of spotting or color marks except the dark tail rings and tear stripes on the face. When half grown, at an age when they are shedding their milk molars, they are still somewhat woolly but are spotted by small black spots quite uniformly over the back. The spots on the feet, throat, and base of the tail show a distinct tendency at this age to form cross-bars as in the African wildcat, *F. ocreata*. In a fossil condition the cheetah is known from the Pliocene of India. At the present time a single living species, *jubatus*, is known which covers an extensive geographical area ranging from the Cape of Good Hope north through eastern Africa and the Nile Valley to Arabia, Persia, and India. It is lacking from the Congo forest area and the wooded portion of the west coast of Africa and from all forest tracts within its general range. The cheetah, like the other large cats, shows considerable geographical variation in the coloration of its coat and may be divided into several recognizable races on color characters. Authors have, however, generally failed to find distinctions between the Indian or the African. Much of the failure to recognize such long-known or described races as *jubatus* and *venaticus* is due to the absence of specimens for comparison. Wild-killed cheetahs of the Indian race, *venaticus*, are very rare in collections, most of the specimens representing this race being captive ones used for hunting, which have lost their slight color characters through the changed environment.

The Indian cheetahs may, as a rule, be distinguished from the African by the absence of the short mane on the neck and the ruff on the under side of the tail, the smaller body size and less numerous spots, the small, interspaced spots between the larger being absent. The African animal splits up into at least four fairly well-defined geographical races. In the Cape region occurs a small-bodied form, *jubatus*, rather like the Indian, with the spots well separated, their color not predominating over the ground-color. Far-

ther north, in the equatorial highlands, this race is replaced by a large-bodied form, *velox*, with more black spots and darker coloration. The arid regions of the White Nile and Lake Chad are occupied by a small-spotted, light-colored race, *sœmmeringii*, which shows a decided pinkish tone to the coloration. The lower altitudes of East Africa and Somaliland support a similarly pinkish-buff animal, but in this race, *raineyi*, the spots are much larger and cover an area fully as great as the ground-color.

The cheetah is fairly common in East Africa. It is diurnal and is found on the bare plains; therefore, it is much more often seen than the leopard where both are equally abundant. It has been suggested that the lion has lost his spots because he grew to frequent open country where he no longer needed them, as do the spotted cats which dwell in the jungle. Unfortunately for this theory, the cheetah, a much more specialized cat than the lion, dwells even more in the open, and nevertheless is spotted, while the mono-colored cougar, a beast of the woodland, is as difficult to see there as any spotted cat. The cheetah lies up in clumps of bush or tall grass, and roams over the plains after its prey. In the sunlight, at a little distance, the spots cease to show, and its color seems like that of a lioness.

The cheetah is far less ferocious and formidable than the leopard. It ordinarily preys on the smaller antelopes, such as gazelles, steinboks, and oribis, up to animals the size of a half-grown hartebeest; yet there are well-authenticated instances of its killing koodoo and waterbuck. It kills its game in fair chase, for it is the fastest animal on earth for a quarter of a mile, or perhaps half a mile. It stalks up to within a hundred yards or so, and then gallops into the fleeing quarry. But it is winded by any long run. If it is



RAINEY CHEETAH, ADULT MALE
From Kapiti Plains, B. E. A.
United States National Museum

RAINEY CHEETAH
From Nairobi
Presented by W. N. McMillan to the National Zoological Park, Washington, D. C.

RAINEY CHEETAHS

within half a mile of cover which it desires to reach, and a horseman seeks to cut it off from one side, it will go two feet to his one, and will probably reach the cover in safety. But in a stern chase a hard rider on a good horse will run it down in a mile or two. Kermit ran down seven in this manner. Seemingly the cheetahs, on these occasions, never put out their full speed, as when seeking to catch fleeing quarry. They were content to gallop easily ahead of the galloping horse, without spurting, until their wind was gone and it was no longer possible to spurt. After a mile or two of fast galloping, according to the start the cheetah had obtained, the horse would be close up. Then the cheetah would suddenly crouch flat on the ground. Apparently when it did this it was completely done up, and it made no further effort either to escape or charge, and was shot as it lay. It is very rare for one to charge; but one did charge Stewart Edward White, and with the utmost determination, too.

Cheetahs are easily tamed, and make good-humored pets. At Juja farm there were three, which Mrs. McMillan used to lead about with a leash. They did not lead well, but were friendly and unconcerned. When sitting down they were so erect that they looked like monkeys rather than dogs or cats. They uttered a very peculiar, bird-like chirp, twisting their lips; when we first heard the chirp we could not believe that it came from the cheetahs, and looked everywhere for the bird.

KEY TO THE RACES OF *jubatus*

Ground-color of body buff without pinkish suffusion; spots on hind feet well marked; dark spots on dorsal region numerous, predominating in area over the ground-color; pelage longer *velox*

Ground-color light, pale pinkish-buff; spots on hind feet small or indistinct; dark spots on back fewer, the ground-color predominating; pelage shorter

Dorsal dark spots larger, ¾ inch in diameter; ground-color lighter than ochraceous; hind feet spotted *raineyi*

Dorsal dark spots smaller, ½ inch in diameter; ground-color ochraceous; hind feet unspotted *sæmmeringii*

HIGHLAND CHEETAH

Acinonyx jubatus velox

NATIVE NAME: Masai, *engingylasho.*
Acinonyx jubatus velox Heller, 1913, Smith. Misc. Coll., vol. 61, No. 19, p. 7.

RANGE.—From the Rift Valley and Laikipia Plateau westward over the highland country as far as the Nile lowlands; north to the latitude of Nimule and south through German East Africa.

The highland cheetah is characterized by its large, close-set black spots, which predominate over the ground-color in area, by the boldly spotted hind legs, long pelage, and large body size. The race has been recently described from a specimen shot by Kermit Roosevelt on the Loita Plains of British East Africa. The typical race, *jubatus*, which inhabits South Africa, differs by having darker ground-color, smaller spots, and smaller body size. The two lowland races, *sæmmeringii*, of the Soudan, and *raineyi*, of the coast of East Africa, are both distinguishable from *velox* by their pinkish-buff coloration and shorter pelage.

The dorsal ground-color of adults is ochraceous, deepest on midline of back and palest on sides and belly, where it shades into cream-buff. The black spots on the back are circular in outline, measuring three-quarters of an inch in

diameter, and are interspersed with numerous smaller black spots, causing the black color to predominate over the ground-color. The spots on the sides of the body are larger but less numerous and cover a smaller area than the ground-color. The legs and under-parts are marked by oblong black spots. The feet are marked by irregular black spots, the forefeet more numerously than the hind, and the bases of the toes also show spots on their dorsal surfaces; but the hair on the under side is dusky-brown. The tail is marked by large black spots above and black rings below, with the terminal portion ringed all around with broad black and narrow pale buffy rings, the tip whitish. The crown of the head and the nape are marked by small black spots as far as the interorbital region. The whole snout from the eyes is uniform ochraceous and banded on the sides by a heavy black tear band from the eyes to the mouth. The sides of the head from the eye to the base of the ear are marked irregularly by small black spots, without, however, any suggestion of a line from the eye to the ear. The chin and upper throat are whitish or cream-buff in color. The backs of the ears are chiefly black, only the tips and the inner sides being buffy. The hair of the nape is long, forming a mane from the head to behind the shoulders. The hair on the median line of the breast and belly is long and mane-like in character. The ventral surface of the tail is marked along its whole length by a broad mane or ruff of longer hair, which at the tips becomes somewhat bushy in character.

The flesh measurements of the typical male which has been used as the type specimen were: head and body, 51 inches; tail, 29 inches; hind foot, 11½ inches; ear, 3⅛ inches. The flesh measurements of adult female specimens fall very slightly below these dimensions. The skulls of adult males range in length from 7 to 7⅞ inches, those of females from 6¾ to 7 inches. The skull dimensions exceed considerably those from any other part of Africa, which would indicate a relatively larger body size than in other races.

A series of specimens have been examined at the National Museum from the Loita Plains, the Laikipia Plateau north of Mount Kenia, and the Uasin Gishu Plateau. The range

of this race no doubt extends northward over the highlands of Elgon to the latitude of Nimule and westward and southward over the higher parts of Uganda and German East Africa.

Rainey African Cheetah

Acinonyx jubatus raineyi

Native Name: Somali, *wer*.

Acinonyx jubatus raineyi Heller, 1913, Smith. Misc. Coll., vol. 61, No. 19, p. 9.

Range.—British and German East Africa from the coast lowlands inland as far as the base of Mount Kenia and the Kikuyu Escarpment, north to Somaliland, and south to central German East Africa.

The cheetah inhabiting the coast-drainage area has been recently described from a specimen shot by Paul J. Rainey near Ulu Station, Kapiti Plains district, British East Africa. This race is a pale-colored, short-haired form having a light pinkish-buff dorsal ground-color. It may be distinguished from the Soudan race, *sæmmeringii*, by the large size of the dorsal spots and the spotted hind feet. The ground-color is pale pinkish-buff, darkest on midline, where it is ochraceous-buff, and paling on the under-parts to cream color. Body marked uniformly by round black spots three-quarters of an inch in diameter, interspaced by occasional small spots or dots. The spots on the legs and belly are elongate in shape and cover the limbs to the toes. The fore-feet are much more conspicuously spotted than the hind, which have the spots small or indistinct near the toes. The toes are much spotted above on a pinkish-buff ground color, but below they are clothed by dusky-drab hair. Tail spotted like the back with the terminal portion marked by five black rings and the extreme tip white. The top of the head and the nape are marked by numerous small black spots, but the snout is uniform ochraceous-buff without spots, and is sharply defined on the sides by a black stripe extending from the eye to the mouth just behind the whiskers and thence passing backward to the angle of the mouth. The sides of the head behind the eye and below the ear are marked by a few black spots, but no evident line

between the eye and base of the ear is thus formed. The ears are pinkish-buff marked by a wide black band covering the lower half of the back. The chin and the upper throat are white. The pelage is short on the dorsal surface, being seven-eighths of an inch in length on the rump. The nape is furnished with a short mane three inches wide extending from the head to behind the shoulders. The midline of the breast and the belly and the whole length of the ventral surface of the tail is further furnished by a ruff or short mane of longer fluffy hair.

In body size and proportions this race is quite identical with the highland race. An adult male from Ulu Station had the following flesh measurements: head and body, 49 inches; tail, 30½ inches; hind foot, 12 inches; ear, 3 inches. Skull length in this specimen is 7½ inches. Specimens have been examined, from the Kapiti and Athi Plains, at the National Museum. Others are recorded by sportsmen from the flanks of Kilimanjaro, near Taveta, and also on the Upper Tana River southeast of Mount Kenia, north of which point they are known to occur in parts of Somaliland. Cheetahs have been reported from the Rift Valley region of central German East Africa, which are doubtless referable to this race.

Soudan Cheetah

Acinonyx jubatus sæmmeringii

Cynailurus sæmmeringii Fitzinger, 1855, Sitz.-Ber. Math. nat. cl. d. K. akad. Wiss., XVI, hft. 2, p. 245.

Range.—Lowlands of the Nile Valley, from the Albert Nyanza northward to Kordofan and westward to Lake Chad and northern Nigeria.

The German naturalist Fitzinger, in 1855, described the Soudan cheetah from a specimen secured on the Bajuda Plains, Kordofan, naming it for the noted physiologist Samuel Thomas von Soemmering, of Frankfort-on-the-Main. The race may be recognized by the small size of the black spots, which do not exceed a half inch in diameter, and are widely separated by the ochraceous ground-color and the absence of spots on the hind feet. A specimen from the

White Nile, purchased at El Dueim, has been examined in the National Museum and another from Lake Chad in the British Museum. It is a rare animal in the Nile district and is seldom secured by sportsmen. Schweinfurth fails to mention it in his list of mammals met with during his exploration of the Bahr el Ghazal, and Von Heuglin refers to it very briefly without mentioning any localities. Heller saw a pair near Gondokoro, but no other member of the Roosevelt expedition met with this race.

CHAPTER VIII

THE SPOTTED HYENA, STRIPED HYENA, AND HUNTING DOG

Introduction to Family *Hyænidæ*

Hyenas

The hyenas are at once recognizable by the peculiarity of their body shape, which is decidedly high-withered, falling away rapidly toward the hips which are supported by very short, weak hind legs. The head is somewhat enlarged but short-jawed and armed with heavy, conical, crushing teeth. The teeth of the hyenas are highly specialized for crushing bones, and for this purpose some of the cheek-teeth have developed into stout, rounded, conical cusps of great strength. The canine teeth are much smaller than in either the dogs or the cats, being more fitted for crushing than for tearing flesh or for grasping prey. In order to make this formidable dental apparatus of great crushing value the jaws are armed with enormous muscles, the bulk of which find attachment on the high median dorsal crest of the back part of the skull. The development of this bony sagittal crest is greater than in any of the other carnivores and furnishes one of the marked distinguishing features of the skull, which otherwise closely resembles that of the cats. The feet are four-toed and furnished by stout, non-retractile canine claws. Large anal glands or sacks are present, and the testes are internal, but beyond this similarity there are marked differences in the sexual

organs in the two genera comprising the family. The hyenas, to the casual observer, appear to be fairly close relatives of the dog family, and few people suspect the really close relationship they bear to the cat family. The structure of the skull and the arrangement of the teeth are strikingly feline, the feet alone being distinctly canine. Some fossil genera have been discovered which tend to link the hyenas with the *Viverridæ*, of which the well-known mongoose is a representative, but the evidence is yet far from satisfactory in this regard. Two strikingly different groups or genera comprise the family: the striped hyena, genus *Hyæna;* and the spotted hyena, genus *Crocuta. Hyæna*, from which the family name has been derived, is the least specialized of the two. It is characterized externally by the long dorsal mane of hair extending from the nape to the tip of the tail, the large pointed ears, dark vertical stripes or bands across the body and legs, and black throat. The sexual organs are normal in structure, but the skull shows decided dental differences. The upper molar is well developed and fits into a long heel on the last lower tooth or carnassial. The skull is somewhat smaller, narrower, longer-snouted, and the body size less than in the spotted hyena, or *Crocuta.* The latter differs by its shorter hair growth, absence of a well-developed dorsal mane, by short ears and the spotted type of coloration. The female sexual organs are quite peculiar in structure and closely resemble those of the male in external appearance. The dentition is more reduced, the upper molar being minute, as in the cats, and the lower carnassial has only a rudimentary heel. The skull is broad, with very broad mesopterygoid fossa, and the body size is considerably greater.

EASTERN SPOTTED HYENA, FEMALE
From Forest Station, West Kenia
United States National Museum

HIGHLAND STRIPED HYENA, FEMALE
From Loita Plains
United States National Museum

SPOTTED AND STRIPED HYENAS

Striped Hyena

Hyæna

The genus *Hyæna* has at the present time two living species, the striped hyena of North Africa and Asia and the brown hyena or strand-wolf of southwest Africa. In former times, however, the genus was much more widely distributed, as evidenced by the several fossil species which have been found in the Pliocene and Pleistocene beds of southern Europe and Asia. The striped hyena is readily recognizable by the long dorsal mane, which extends from the head along the nape and over the back to the tail, and by the blackish transverse stripes on the body and legs. In coloration, body shape, and general appearance it is minutely imitated by the aardwolf, a somewhat smaller carnivorous mammal having rudimentary teeth and an insectivorous diet. In the east equatorial regions of Africa the two animals share the same territory. The close resemblance in color pattern appears to be purely an accidental affair and not a case of mimicry. The dentition of the striped hyena is less reduced than that of the spotted genus, the upper molar being well developed and functional, and the lower carnassial tooth has a long heel behind which opposes the molar when the jaws are closed and is functional during mastication. The female sexual organs are quite normal in structure, and the relative body size of the two sexes is that usual among carnivores, the female being somewhat less in size than the male. No sexual color differences are apparent. In German and British East Africa the striped hyena reaches its southern limit of distribution and is there represented by two races, a highland form and a low desert form.

This hyena was not uncommon in certain parts of East Africa, but we never saw it abroad in the daytime, and only caught it in traps. It seemed more nocturnal, shyer, and less bold and ferocious than its big, spotted brother. There are spotted, striped, and brown hyenas. Their habits are all substantially alike, and their ranges overlap. In

view of their habits it seems quite impossible that the coloration of their coats can have even the smallest effect upon their well-being; and it is absolutely impossible that the totally different types of coloration of the three species can all have the same effect from the standpoint of concealment. It seems probable that these totally different coloration patterns have been developed without reference to the concealing quality of any of them; and it is certain that no one of them is now of more value than the others in the animal's life, from the standpoint of concealment.

KEY TO THE RACES OF *hyæna*

Dorsal ground-color pale-buff without pinkish suffusion; stripes black and broader; mane tipped with black; feet uniform dark-brown *schillingsi*

Dorsal ground-color pale pinkish-buff; stripes dark seal-brown and narrower; mane tipped with dark-brown; feet buff or ochraceous mottled with brownish-drab *bergeri*

HIGHLAND STRIPED HYENA

Hyæna hyæna schillingsi

NATIVE NAME: Swahili, *kungugua*.
Hyæna schillingsi Matschie, 1900, Sitz.-Ber. Ges. Nat. Freunde, Berl., p. 55.

RANGE.—Kilimanjaro region and Rift Valley of German East Africa, northwest to the Victoria Nyanza, Loita Plains, and Kedong Valley in British East Africa.

The striped hyena is a rare animal in East Africa, and is seldom met with by the sportsman. Willoughby and Hunter saw specimens during their trip to Kilimanjaro in 1887, and were the first to report its occurrence, but it was not until a decade later that specimens were actually secured by Schillings, for whom the race was named by Matschie in 1900. More recently specimens have been secured

by various expeditions on the Loita Plains, the Kedong Valley south of Lake Naivasha, and at Voi.

The highland race of the striped hyena shows a grayer coloration and more distinctly striped coat than the desert race. The ground-color is pale-buff without any pinkish suffusion, the stripes are quite blackish, the feet are uniform dusky-drab, and the dorsal mane is tipped by black. The body size is somewhat larger than the other equatorial races. An adult female of this race secured on the Loita Plains by the Roosevelt Expedition and now in the National Museum had the following flesh measurements: head and body, 43 inches; tail, 11¾ inches; hind foot, 8½ inches; ear, 6 inches. Greatest length of skull, 9⅝ inches.

Desert Striped Hyena

Hyæna hyæna bergeri

Native Names: Somali, *whera* or *didar*.

Hyæna hienomelas bergeri Matschie, 1910, Sitz.-Ber. Ges. Nat. Freunde, Berl., p. 361.

Range.—Desert region of British East Africa from the southern slopes of Mount Kenia and the Mau Escarpment northward throughout the Lake Rudolf basin, southern Abyssinia, and Somaliland.

A specimen of the striped hyena from the Elgeyo Escarpment in the Uasin Gishu Plateau region has been made the type of the desert race by Matschie. The race has been named for its collector, Doctor Berger, who has given us "In Afrikas Wildkammern," an excellently illustrated account of his hunting expedition through East Africa and Uganda. The desert race may be distinguished from the highland race by its pale-pinkish ground-color, less conspicuous stripes, brownish tips to the dorsal mane, light-colored buff feet, with little or no dusky-brown mixture, and smaller body size. Considerable individual variation in color is shown by a series of skins from the Northern Guaso Nyiro River in which the feet vary from pale-buff to wood-brown and the hair tips of the dorsal crest from dusky-brown to seal-brown or blackish. The dorsal stripes also vary in intensity, but they are never as heavy or black as

in the highland race. The tail varies much in length, ranging in adults from 12¼ to 14½ inches. The skulls show considerable variation in size and shape, quite equalling in this respect the spotted hyena. In a series of seven female skulls the range in length is 8¼ to 8¾ inches, and in breadth 5⅜ to 5⅞ inches. The male skulls show less variation, being usually 9½ inches long by 6 inches wide. The flesh measurements of an old male from the Northern Guaso Nyiro River were: head and body, 42 inches; tail, 13½ inches; hind foot, 8¼ inches; ear, 5¾ inches. The females average somewhat less than these dimensions.

Many years ago Latreille described a race, *hienomelas*, from the Atbara River or northern slopes of the Abyssinian highlands, which may upon the study of further specimens be found to be indistinguishable from the present race, in which case the latter name would give way for the older one, proposed by Latreille. Recently Lönnberg has given a new name to the striped hyenas of the Northern Guaso Nyiro River, but the large series in the National Museum from that locality are quite indistinguishable in color or other characters from the description of *bergeri*, the type of which was secured at the extreme southwestern limit of the race, near the base of the Elgeyo Escarpment.

Spotted Hyenas

Crocuta

Crocuta Kamp, 1828, Oken's Isis, XXI, Heft XI, p. 1145; type *Hyæna crocuta.*

The spotted hyenas have by most writers been combined with the striped in a common genus, *Hyæna*. A careful comparison of the two groups, however, leads to the discovery of many differences of a fundamental character and shows a really wide gap in structure between the two hyenas. There are decided differences in dentition, in skull shape, in the genital organs, in body shape, and hair growth, any of which are of generic importance. The spotted hyena has the dentition much more reduced, the molar being a mere rudiment or missing altogether, while

the lower carnassial tooth lacks a well-developed heel. The skull is wider, shorter-snouted, and has a narrower mesopterygoid fossa. The sexual organs of the female are very peculiar and resemble in external appearance those of the male—a condition quite unique among carnivorous mammals. It is owing to this peculiarity that the animals are believed by most of the negroes and many sportsmen to be hermaphrodite. Externally, the spotted hyenas differ from the striped by the small size of the ears, the absence of a dorsal mane of long, stiff hair extending from the nape to the tip of the tail, and the spotted character of the coat. In the spotted hyena the female exceeds the male in size, a sexual peculiarity not found in the striped hyena or in any other existing carnivore. The young at birth are uniform seal-brown, without any indication of spots or markings of any sort. After a few months have passed, their coloration becomes paler in spots and assumes gradually the heavily spotted coat characteristic of the immature. Two young are produced at a birth. The genus *Crocuta* is much more highly specialized than *Hyæna*, and is quite catlike in dental characters and skull shape. A single living species, *crocuta*, is known, which is confined in distribution to Ethiopia or Africa south of the Sahara Desert. Several geographical races have been described; but, owing to the great individual variation to which some of them are subject, their status is at present quite uncertain. During the Pleistocene age a species very closely related to the existing one occurred in southern Europe as far west as the British Isles and also on the Mediterranean coast of Africa and eastward as far as India.

The spotted hyena was common through East Africa and Uganda. Its strange cry was heard on most nights, wherever we were, and we often came across it in the daytime; for, although most active after nightfall, it frequently prowled abroad in the mornings and afternoons, in lonely lands. Generally, however, in the daytime it retired to its lair, which might be a cave or a hole under a stone, or

merely a patch of reeds or bush. Normally it was solitary, but quantities assembled around any big dead beast. Kermit rode down several, although sometimes, if the beast had a long start, only after a good chase. Hyenas are noisy; besides the usual questing cry, they at times cackle and screech and more rarely laugh.

They are queer creatures. Ordinarily they are scavengers, feeding on carrion. Yet they occasionally kill mules, cattle, donkeys, and young rhinoceros. Their jaws are so powerful, their strength is so great, and they are so tough, that only a number of big, fierce dogs can kill one. When hungry they pounce on and carry off dogs. Yet when hunted they are very cowardly. A big Airedale terrier, belonging to a ranchman we visited, would unhesitatingly attack a hyena single-handed, and harass the beast so that the hunter could come up and shoot it. To a man there is absolutely no danger in hunting them; the utmost they will do is to snap at a stick when wounded and at bay. They have not a thousandth part of the fury and reckless prowess of the leopard. Yet they are far more apt than the leopard to prey on human beings, even full-grown men; and in certain districts where they are bold and numerous it is dangerous for any man to sleep alone in the open. Their attacks are always made at night, with extreme caution, and when the victim is sleeping. Usually they seize the face, and we saw more than one native who had been frightfully scarred in this manner, although the beast had been driven off. An English officer, Major Coryndon, was once seized by the hand by a hyena while he was sleeping in the open; he struggled so that the beast left him and ran off into the darkness; whereupon he lay down again with his loaded rifle

ready, and when his hungry assailant returned he shot it dead. In Uganda, when we were passing through, the hyenas had become confirmed man-eaters because of devouring the innumerable natives who died of sleeping sickness. They haunted the ghastly sick-camps into which the officials gathered the sufferers. After a few experiments they found that the dying men and women could offer little resistance, and after nightfall they broke into their huts and carried them off; and they grew steadily in numbers and ferocity. It became necessary not only to build stiff fences round the camps but to station strong guards of soldiers in them, and every night there were repeated shots fired in killing or driving away the marauders.

In fact, the hyena is a singular mixture of abject cowardice and the utmost ferocity. Usually feeding on carrion, and often hesitating to attack even the weakest animal if it is unhurt and on its guard, the ravenous beast will, on occasions, even when single but especially when in troops, assail very formidable creatures. A troop has been known to kill a half-grown rhinoceros which had returned to the body of its mother, slain by hunters. Not only sheep and goats but donkeys, mules, cattle, and dogs are at times destroyed. In killing men, women, and especially children, a man-eating hyena will penetrate big villages; one took a native from a hut in Nairobi itself. When in troops they have been known to seize animals that have been wounded by hunters, and to attempt to stand off the hunters. We have never known them in such a case actually to attack the hunters. But under certain circumstances they do attack lions, which seems quite as extraordinary. Ordinarily the hyenas merely attend the lion at respectful distance, eager to get

whatever he leaves, and they occasionally pay with their lives if they grow too impatient. But Donaldson Smith has related an instance in which a pack of hyenas entered into a regular fight with a couple of lions, near a bait, and got the best of it. Once we were sleeping near the body of an elephant. There were many hyenas feeding at the carcass. Toward morning a lion came near, and menaced the carrion feeders, uttering a long-drawn, moaning sigh. The hyenas, however, refused to be frightened by the self-invited guest, and they responded to his challenge with the most extraordinary chorus of noises to which we ever listened. They refused to leave the carcass, or to admit the lion to his share of the banquet; and the lion made off without venturing to try conclusions with them. More extraordinary still is the fact that the hyenas sometimes kill and devour very old and crippled lions. Once Lord Delamere shot and very badly wounded a lion, which in the course of the fray mauled him and both his gun-bearers. Camp was pitched where the wounded men lay, while the lion, too badly hurt to leave, crawled into some bushes but a short distance off. After darkness the hyenas assembled, fell on the wounded lion, and after a very noisy fight killed and ate him.

Hyenas are easily tamed, and in many cases are docile, intelligent, and affectionate. At the Cairo zoological park we saw one which was as devoted as a dog to its keeper. It loved to be stroked, and would lie belly upward while he rubbed it. In ancient Egypt they were tamed and used with greyhounds for the chase; and, extraordinary to relate, they were also fattened for the table, being stuffed with food like so many Strasburg geese.

KEY TO THE RACES OF *crocuta*

Pelage long, decidedly more than one inch in length on the rump; spots large on the back
  Ground-color ranging from buff to tawny, seldom showing a gray cast — *germinans*
  Ground-color pale-gray — *thomasi*

Pelage short, less than one inch in length on the rump; spots smaller on the back; ground-color pale-buff — *fisi*

EASTERN SPOTTED HYENA

Crocuta crocuta germinans

NATIVE NAMES: Swahili, *fisi;* Masai, *ol ngojine.*
Hyæna germinans Matschie, 1900, Sitz.-Ber. Nat. Freunde, Berl., p. 26.

RANGE.—Highland and coast drainage area of British and German East Africa from Mount Elgon southward throughout the whole of German East Africa to Nyasaland and the Zambesi drainage.

The spotted hyena inhabiting German East Africa was named by Doctor Matschie *germinans*, owing to the great individual variation which they exhibit in coloration. This color variation has been observed and mentioned by almost every sportsman who has recorded his observations of spotted hyenas from eastern equatorial Africa. The typical specimen upon which Matschie based his name came from Lake Rukwa, a small body of water lying between Lakes Tanganyika and Nyasa on the western frontier of German East Africa. In 1908 Lönnberg twice redescribed the present race, giving distinct new names to the two extreme types of coloration observed in specimens from the southern slopes of Mount Kilimanjaro. One of these names, *kibonotensis*, he applied to a reddish animal having a short tail, the other, *panganiensis*, to a grayish one with a longer tail. These two color and tail extremes, together with every intermediate stage, are represented in specimens from the Loita Plains and the Uasin Gishu Plateau in the National Museum collection. They will be

found to occur in any large series from any locality throughout the distribution of this hyena and are to be regarded simply as evidence of the variability of the race.

It is difficult to define a race so variable as *germinans* in color and proportions. The ground-color of the upper parts ranges from a light-buff through ochraceous to tawny, and occasionally a light-grayish cast also occurs, but the usual ground-color may be said to be ochraceous-buff. The dark spots are fairly numerous and large on the back and occupy an area quite equal to the ground-color in extent. A few large spots, two or three inches in diameter and several times larger than the others, are usually present on either side of the midline near the middle of the back. The feet and lower part of the legs also show much variation, ranging in color from clove-brown to pale-buff. The young and immature animals are dark-colored, with large spots and dark feet, and are distinctly uniform in appearance, giving no suggestion of the great variation which occurs in the adult. Other races of the spotted hyena do not appear to share this extensive color variation of *germinans*, but have well-established color differences. The eastern spotted hyena may usually be known from either *fisi* or *thomasi* by the larger size of its dorsal spots, long coat, and tawny or buffy coloration. From the Cape race of South Africa it is distinguishable by its smaller body size and narrower skull.

An adult male from the Loita Plains had the following flesh measurements: head and body, 50 inches; tail, 11 inches; hind foot, 9½ inches; ear, 4¼ inches. The greatest length of the skull in this specimen was 10¼ inches. The female averages greater than these dimensions somewhat, the largest specimen examined being a female from the Loita Plains which has a skull length of 10⅞ inches. Specimens have been examined in the National Museum from the Loita and Kapiti Plains, Laikipia and Uasin Gishu Plateaux, and the Kenia forest on the south and west slopes of the mountain. The spotted hyena is universally distributed from the coast as high as the moorland at ten thousand feet altitude, and is absent only from the inner depths of forests and from the waterless desert tracts.

Marsabit Spotted Hyena

Crocuta crocuta fisi

Crocuta crocuta fisi Heller, 1913, Smith. Misc. Coll., vol. 61, No. 22, p. 5.

Range.—Desert lowland region from the Northern Guaso Nyiro River drainage north through the Lake Rudolf region to Abyssinia and eastward to the coast.

Specimens of the spotted hyena inhabiting the low, arid desert region of the Northern Guaso Nyiro and Mount Marsabit region are decidedly shorter-haired, lighter-colored, and smaller-spotted than the variable *germinans* of the highlands to the southward. This hyena has recently been described as *fisi* by Heller from specimens from the Merille water-holes situated in the desert midway between the Guaso Nyiro River and Mount Marsabit. It is further distinguishable from the Somaliland race, *rufipicta*, also a desert inhabitant, by the reddish color of the spots and the more buffy or ochraceous ground-color of the latter.

The ground-color is pale-buff, spotted irregularly over the back by rather small black spots varying in diameter from a quarter to three-fourths of an inch and covering an area only about one-fourth that of the ground-color. The spots are heaviest and most distinct on the midline of the back and faintest on the neck, sides of the body, underparts, and shoulders, but the head and the feet are unspotted. The tail is basally like the back in color, with a few dark spots, the terminal one-half being covered by a bushy black tuft of long, coarse hair. The feet are uniform olive-brown to the toes, in contrast to the spotted upper portions of the legs. The head is grizzled-buffy and blackish on the crown and sides, the snout, muzzle, lips, and chin being uniform dusky-black in contrast. The whiskers and the long hairs above the eyes are black. The throat and the sides of head below the ears are uniform light-buff without darker spots. The back of the ears show a grizzled appearance, due to the scantiness of the short buffy hair which allows the blackish skin to show through, but the ears on the inner side are more heavily clothed by longer whitish hair. The hair is short, the length on the

rump being only one-half of an inch. The nape is furnished with a short mane of uniform light-buff color in which the longest hairs have a length of two inches.

The size and relative proportion of parts in *fisi* are quite identical to those found in *germinans* and need not be repeated here. A large series of specimens are in the National Museum, collected by the Rainey expedition in the desert region between Mount Marsabit and the wagon ford on the Northern Guaso Nyiro. They are chiefly from the water-holes of Merille, Longaya, Koya, and Karo, and from the Guaso Nyiro River near its junction with the Lakiundu. These specimens show remarkable uniformity in ground-color and size of spots compared to the variable *germinans*, from which they are readily distinguishable by color and shorter pelage.

Ankole Spotted Hyena

Crocuta crocuta thomasi

Native Name: Luganda, *empisi*.
Crocuta thomasi Cabrera, 1911, Proc. Zool. Soc., p. 98.

A specimen of hyena in the British Museum from Ankole, Uganda, collected by Sir Harry Johnston, has recently been made the type of a new race by Cabrera and named for the curator of mammals of that institution, Oldfield Thomas. The character assigned to the race by the describer, who had a series of but three specimens, is the pale-grayish coloration. It is doubtful, however, if the race is a valid one, being founded on so small a series and living in close proximity to the highly variable *germinans*. More specimens are needed from Ankole to establish the limits of individual variation in this questionable race.

Introduction to Family *Canidæ*

Dogs and Wolves

The only African member of the dog family which attains sufficient size to be classed as big game is the hunting dog. It is quite the smallest member of the big-game

carnivorous mammals, but owing to its organized ferocity consequent upon its gregarious habits the species assumes an importance far beyond what its bodily size would warrant. The true dogs of the genus *Canis* are represented in East Africa only by the jackals, which seldom exceed the dimensions of a red fox and live a solitary or at most a paired existence of rapine on smaller animals.

Hunting Dog

Lycaon

Lycaon Brookes, 1827, in Griffith's Cuvier's Anim. Kingd., V, p. 151; type *Lycaon pictus*.

The hunting dog was considered by the first naturalists to whom it became known, namely, Burchell and Temminck, as a species of *Hyæna*. They were led to this conclusion, no doubt, by the spotted coloration, thin coat, four-toed feet, the broad skull, and short, wide jaws. The hunting dog, however, is closely related to the typical dogs of the genus *Canis*, from which it is separated chiefly by the four-toed character of the forefeet and slight differences in dentition. There are no differences in number of teeth between the two genera, but the lower carnassial tooth differs from that of the true dogs by having only one cusp on the heel, a peculiarity which it shares with *Cuon*, the dhole of India to which it is most closely related. The skull of *Lycaon* is easily recognizable from that of a wolf or a jackal by its much greater breadth across the palate and the shortness of the jaws. Externally, the hunting dog exhibits marked peculiarity by its blotched coloration, which lacks any definite pattern on the body, the three colors of black, yellow, and white being combined in almost every conceivable proportion and pattern in different individuals. The hair covering is usually short and often so scanty that the black skin forms the predominant color. The head has, however, a definite color pattern, the snout being black as far back as the eyes, the rest of the head ochraceous in color, with a broad black median stripe over the crown and

down the nape. The ears are extremely broad and conspicuous, resembling in their great size some of the foxes, and are black on the back with yellow inner sides. The tail is of medium length and rather scantily haired, the terminal tuft of white hair being much smaller than the brush of a wolf. At the present time the hunting dog is confined to Ethiopian Africa, where it ranges from the Cape north throughout the eastern part of the continent to the limits of the Abyssinian highlands and Lake Chad. Formerly it ranged beyond the limits of Africa through Europe to the British Isles, where fossil evidence of it has been obtained in the Pleistocene beds of Wales. A single living species, *pictus*, is recognized by naturalists, of which several geographical races have been named on differences detected in the proportions of the three colors in the coat, by relative differences in body size, and thickness of pelage. The characters given for the various races, however, are based on the examination of so few specimens that they can in no case be said to be established, but the study of more material in the future will without doubt lead to the discovery of definite characters for many of the races now named. Names have been applied to British East African, Somaliland, and Lake Chad races, but it seems best at the present time to recognize only the East African race, which alone has recognizable characters over *pictus* of South Africa.

This pied creature is found throughout East Africa, although it is rare in most places. Hunting hounds usually go in big packs. They master all the smaller and the young of all the larger antelopes, and there is reason to believe that at times, although rarely, they kill even the biggest antelope, and half-grown buffalo also. Yet we saw zebras feeding near them without heeding them, and also rushing at them and driving them off when they came too close. They are extremely destructive to game, and at times to goats and sheep; and they will menace man, al-

EAST AFRICAN HUNTING DOG, MALE
In the New York Zoological Park

EAST AFRICAN HUNTING DOG, MALE
Caught at Merrille near Mt. Marsabit
Presented by Paul J. Rainey to the New York Zoological Park

though we have no authentic instance of their actually attacking him. But Mr. Rainey, in the Northern Guaso Nyiro desert, saw a party of wild dogs chasing a lion; they did *not* bite him, but he was manifestly uneasy and concerned and trotted sheepishly along, endeavoring to get out of their way.

East African Hunting Dog

Lycaon pictus lupinus

Native Names: Swahili, *bizi, mbwa-mwitu;* Masai, *osuyai;* Kavirondo, *sudthi;* Dinka, *kwaty.*

Lycaon pictus lupinus Thomas, 1902, *Ann. & Mag. Nat. Hist.*, IX, p. 439.

Range.—East Africa and Uganda from the coast and desert tracts inland to the high plateaux, lacking only from the forest and alpine country.

Hunting dogs were met with by some of the first explorers to enter the upper Nile region. Heuglin reported them in 1869 from the White Nile, and a few years later Schweinfurth mentioned them from the upper waters of the Bahr el Ghazal and the Nile-Congo watershed. Speke and Grant, however, were less fortunate in this regard and failed to learn of their occurrence in the region they traversed. On the East Coast, however, it was not until comparatively recently, in 1887, that Willoughby first reported the hunting dog from the Kilimanjaro country. It is now well known that they range from the coast and low desert country inland to the highlands wherever there is sufficient game for food. They are nowhere numerous, but wander about in packs over much territory and are seldom met with by sportsmen. The East African race has been described by Oldfield Thomas from specimens shot by C. S. Betton near the Ravine Station on the headwaters of the Nyuki River, at the point where it is crossed by the equator.

A typical specimen of the East African race has the color on the back irregularly blotched black and ochraceous-yellow in about equal proportions, with scarcely no white, and with the back of the ears black. The hunting dog

from South Africa differs by being chiefly ochraceous in color, the black being but a small per cent of the dorsal coloration, and the back of the ears differ by being chiefly ochraceous instead of black. Much individual variation in coloration, however, exists and no two specimens are marked on the back quite alike or in the same proportion with the three colors, black, ochraceous, and white. This variability in coloration is well shown by a series of six adults, two females and four males, shot from the same pack and collected by the Rainey expedition on the Loita Plains. In two of these specimens the black areas predominate over the yellow on the body, while in the other four the yellow is somewhat in excess of the black. One of the specimens has a white spot on the shoulder, but in the others no white appears in the coloration. All of the specimens show some white blotches on the under-parts, particularly the breast, but the predominant color below is black. The legs are irregularly striped and marbled on the outer side by white, the white area being equal to that of the black and yellow combined. The tail is another extremely variable feature in color. The white tip varies from a few white hairs to two-thirds the tail length in extent. The median portion is usually black, this part varying from a narrow ring one-quarter of an inch wide to two-thirds the whole tail. The basal one-third is ochraceous in all the specimens. The head and nape are the only portions which show a definite and constant color pattern. The nape and crown of the head are uniform ochraceous, marked by a wide black stripe along the median line. The snout from the eyes forward and the sides, chin, and forethroat are uniform black, as are also the backs of the ears. The inner side and the extreme base of the latter are ochraceous, like the crown and cheeks. Aged specimens often show very little hair, being quite hairless and slaty-black like Mexican hairless dogs. The coat is longest and heaviest in the young adults. There are no sexual differences in color. Puppies and immature specimens are quite blackish, with little or no yellow and whitish except on the terminal tail tuft.

The flesh measurements of an old male from the Loita Plains were: head and body, 38 inches; tail, 15 inches; hind foot, 9¼ inches; ear, 5½ inches. The female is some-

what smaller than the male, and has considerably smaller teeth. The longest skulls in a series of eleven are: male, 8¼ inches; female, 7⅞ inches. Specimens have been examined in the National Museum from the Kapiti and Loita Plains and Kamiti Farm, British East Africa. Others have been seen in the Northern Guaso Nyiro and Marsabit districts, Maji-ya-Chumvi Station near Mombasa and in the Gondokoro district of northern Uganda.

CHAPTER IX

PIGS

Suidæ

AFRICA is remarkable for the peculiarity of its pigs. It is a land in which pigs have run riot and evolved such grotesquely ugly forms as the wart-hog. Three very distinct genera occur wide-spread throughout the tropical part of the continent. Two of these, the wart-hog and the forest hog, have doubtless originated on the continent, while the third, the bush pig, is of European or Asiatic derivation. The true pigs as a family are distinguished by the simple or primitive condition of the feet, which have all four toes well developed, but the lateral pair show signs of atrophy, while the middle pair are decidedly enlarged and support the weight of the body. The canine teeth are enlarged into cutting tusks, and the tip of the snout is broadened into a flat disk for rooting. This expanded snout is supported by a peculiar bone, the prenasal, which lies embedded between the tips of the nasal and the premaxillary bones. The stomach is simple, without the complicated chambers of the ruminants. The pigs are moderate or small-sized ungulates, without horns or antlers. They are confined to the Old World, ranging from the temperate region of Asia southward throughout the tropics and westward through Europe to the British Isles and south over the continent of Africa.

KEY TO THE GENERA OF *Suidæ*

No warts on cheek below the eye; upper tusks short, bent downward, their points cut obliquely off by wear on the short lower tusks; body well haired, colors reddish or black, with a white dorsal mane; skull of boar with a bony process above upper canine; first lower premolar tooth wanting *Potamochœrus*

A prominent wart below the eye; upper tusks long, curved upward and inward, only their lower edge coming in contact with the cutting edge of the lower incisor tusks

Wart below eye shelf-like and horizontal, not conical, in shape; body well haired, but dorsal hair not forming a longer mane; upper canines smaller and less curved inward; skull with a high lambdoidal crest and a deep hollow on crown or parietal region; last molar transversely ridged, not wearing down to a flat surface, short; head not enlarged *Hylochœrus*

Wart below eye conical, and another on sides of head near mouth; a prominent ridge, covered by white whiskers, on lower part of cheek; upper tusks enormously developed and curved inward and upward in a semicircle; skull without hollow in parietal region; last molar long, occupying more than one-half the tooth row, crown with flat surface; head much enlarged; hair covering scanty on sides and under-parts *Phacochœrus*

BUSH PIG

Potamochœrus

Potamochœrus Gray, 1852, Proc. Zool. Soc., p. 131; type *P. koiropotamus* of South Africa.

The bush pigs are closely related to the genus *Sus*, of which our common domestic pigs are familiar representatives. They represent an African branch which has diverged slightly from the original *Sus* stock. The boars have developed on the skull above the upper canine teeth a bony growth, or process, which projects upward an inch or

two to the level of the nasal bones, the tip of the process giving rise on the sides of the snout to a low, hairy wart. Bush pigs differ further by the loss of the first lower premolar, which in the common pig is a fairly well-developed tooth lying isolated midway between the second premolar and the enlarged lower canine tooth. The female differs from *Sus* by the lesser number of mammæ, which are but three pairs. In coloration bush pigs may usually be known by their bright-red color, and on this account they are often called red river-hogs, a term, however, which is applicable only to the West African species, *porcus*. In eastern Africa the old boars usually lose their red color, which is replaced by black in adult life, at which time they assume quite a dark coat, relieved only by the whitish mane and head. The newly born young are marked by longitudinal stripes of pale-yellow or buff on a dark-brown ground-color. Bush pigs are inhabitants of forest or dense bush country and are found everywhere in Africa where such cover occurs, from the Cape to the northern frontiers of Abyssinia and the Soudan, and from sea-level to the upper limits of forest growth, or to an altitude of ten thousand feet in the equatorial highlands. Several fossil species have been found in the Miocene of India which have a close resemblance to bush pigs in tooth structure, but the evidence is too fragmentary to warrant their identity with *Potamochœrus*, which is quite unrepresented in the later Tertiary beds of Asia or Europe. A race known to naturalists as *larvatus* exists at the present time on the island of Madagascar, but as it is scarcely distinguishable in either color or skull characters from the mainland races, it is doubtless a recent importation through the agency of man and has no significance as showing a recent land connection between Madagascar and the continent of Africa. The mammal fauna of Madagascar is so peculiar and limited to so few types that the island must have remained isolated throughout most of the Tertiary time to have prevented the introduction of any of the modern African forms of antelopes and carnivores. The only other existing African ungulate which had representatives in Madagascar is the pygmy hippopotamus, which was represented by two species during the Pleistocene age on the island. Two species of bush pig are

recognizable in Africa, the bright sorrel-red species of West Africa, called *porcus*, and the variegated species of eastern Africa and Madagascar, named by Desmoulins *koiropotamus*, a name usually corrected to *chœropotamus*. Various geographical races have been described of the latter species, but none of them can be said to be more than provisional, owing to the small number of specimens upon which they have been founded and the great variability in coloration and skull shape to which bush pigs are subject. The accumulation of further material will no doubt show the limits of individual and sexual variation in structure and coloration and lead to the establishment of some of the races now considered synonymous with the older described ones. The territory covered by the present work is inhabited by two recognizable forms: an East African, *dæmonis*, and an Abyssinian and Nile race, *hassama*.

KEY TO THE RACES OF *koiropotamus*

Adult boar coloration a mixture of black and white on body and legs; hair long and abundant; bony process projecting above canine tooth long and knobbed, reaching the level of the nasal bones; body size larger, skull length more than 13 inches *dæmonis*

Adult boar coloration uniform black on the sides of the body and the under-parts, and not showing mixture with white; hair short, on the sides scanty, allowing the black skin to appear; bony process above canine tooth short, only reaching half-way to the level of the nasal bones; body size smaller, skull length less than 13 inches *hassama*

EAST AFRICAN BUSH PIG

Potamochœrus koiropotamus dæmonis

NATIVE NAMES: Swahili, *ngruwe;* Luganda, *embizi.*
Potamochœrus chœropotamus dæmonis Major, 1897, Proc. Zool. Soc., p. 367.

RANGE.—German East Africa northward through British East Africa to the Tana River and Mount Kenia, and through Uganda as far as the highlands east of Nimule.

Doctor Forsyth Major, in 1897, in his monographic re-

vision of the bush pigs, described the East African race as *dæmonis*, basing his description upon a single adult female specimen collected by the Reverend W. Morris on the slopes of Mount Kilimanjaro. The differences assigned by Major were the narrowness of the skull behind the orbits and the black coloration of the body, which showed very little reddish or tawny hair. A female specimen collected by Doctor W. L. Abbott on Kilimanjaro is, however, quite a bright red on the body and is not distinguishable in color from specimens from the Kikuyu forests of Mount Kenia and Nairobi. An old boar from Nairobi shows a mixture of white and black hair on the body, with a whitish dorsal mane and a white head, practically no reddish or tawny color showing anywhere. The ears are black and the legs blackish with a sprinkling of white hairs down the front of the legs. The female from Kilimanjaro is rufous or ferruginous on the sides of the body, with a white dorsal mane, black legs, and white head. Specimens from Uganda in the British Museum are quite like these in general coloration as well as shape of skull. The Nairobi boar measured in the flesh: head and body, 51 inches; tail, 14 inches; hind foot, 10½ inches; ear, 5½ inches. Greatest length of skull, 13¾ inches. The length of an adult female skull is 13 inches.

Bush pigs, although quite abundant, are seldom secured by sportsmen, owing to their nocturnal habits and the dense nature of the cover in which they dwell. They are more abundant about the edges of native shambas than in uninhabited regions and have no difficulty in outwitting the simple devices planned by the natives for their destruction. Much damage is done to the native crops by the night forays of the bush pigs, as they travel in herds of from ten to twenty individuals or more. Specimens are exceedingly rare in museums, and in no institution are any of the races represented by a series of individuals from the same spot which would make possible the determination of the limits of individual variation. Single specimens are in the National Museum representing Nairobi, Kilimanjaro, the Mau forest, and the Taita Hills. A few other specimens have been examined in the British Museum from Kilimanjaro; the Tana River, and Uganda.

EAST AFRICAN FOREST HOG
Escarpment Station, Kikuyu Forest, B. E. A.
Mounted group in the American Museum of Natural History, New York.

EAST AFRICAN WART-HOG, MALE
Shot by Theodore Roosevelt, Kamiti Farm
United States National Museum

EAST AFRICAN WART-HOG, FEMALE
Presented by W. N. McMillan to the National
Zoological Park, Washington, D. C.

THE FOREST HOG AND WART-HOG OF EAST AFRICA

Abyssinian Bush Pig

Potamochœrus koiropotamus hassama

Native Names: Abyssinian, *assame;* Argo, *askarmar.*
Nyctochœrus hassama Heuglin, 1863, Nov. Act. Leop. XXX, pt. 2, p. 7.

Range.—Abyssinian highlands southward through the Lake Rudolf basin to the Northern Guaso Nyiro River in British-East Africa, and in the Nile Valley southward through the Bahr-el-Ghazal drainage area.

Rüppell was the first naturalist to mention the Abyssinian bush pig, which some years later was described and named by Heuglin, who applied to it the native Abyssinian name of hassama. He gave the habitat of his new pig as the highlands generally, but later in his "Reise in das Gebiet des Weissen Nil" gave the particular locality of the species as the Hawash Valley. Major, in his monograph, has figured the skull of Heuglin's specimen and called attention to the real characters of the race, the chief of which is the shortness of the bony process projecting above the upper canine. In the Abyssinian race this process reaches only halfway to the level of the nasal bones, having only one-half the development found in the other races. This lesser development of the structure, which separates the genus from *Sus*, seems to point to the intermediate or less specialized character of the most northern race and the one geographically nearest *Sus*. There is also a difference in the coloration in the northern race, which in the adult boar shows white only on the head and the dorsal mane, the sides of the body, the under-parts, and the legs being quite black. The female and immature animals are quite rufous-red on the sides, and strikingly different in color from the old boars.

Only a single specimen of this pig has been available for examination. This one is an old boar collected by the Rainey expedition on Lololokui, a table-topped mountain situated north of the Northern Guaso Nyiro River. The skull of this specimen shows the short character of the bony process above the canine well, and is in general shape quite identical to the figures of Heuglin's specimen. The flesh

measurements of this specimen were: head and body, 47 inches; tail, 16 inches; hind foot, 9¼ inches; ear, 7 inches. Greatest skull length, 12⅞ inches. These measurements, compared to those of an adult boar of the East African race, show less body size, greater length of tail and ears, and shorter feet. The specimen here described was one of a herd of fifteen met with on the broad summit of Mount Lololokui, at an altitude of six thousand feet. This herd came nightly to the springs to drink and were occasionally seen in the daytime, the mountain being quite without human inhabitants. The stomach of this specimen contained the remains of the white, bulb-like roots of the *Sansevieria* plants which grew abundantly in patches on the slopes of the mountain and resembled closely in habit the smaller yuccas or Spanish daggers of Arizona or California.

Forest Hog

Hylochœrus

Hylochœrus Thomas, 1904, Proc. Zool. Soc., p. 193; type *H. minertzhageni.*

As recently as 1904 a remarkably distinct giant hog was discovered in the forests of Mount Kenia and the Nandi Escarpment by Lieutenant Minertzhagen, of the East African Rifles. The specimens collected by this officer consisted of two male skulls from Nandi and the imperfect skin of a female from Mount Kenia. This material showed the giant forest hog to differ widely in skull structure or shape from other known pigs and to require generic separation from them. Oldfield Thomas, the original describer of this new genus and species of pig, has pointed out its close structural resemblance to the wart-hog as well as the peculiar elevated crest of the parietal part of the skull, the concavity on the crown of the head and some peculiarities in the teeth not possessed by any other genus of pigs. The forest pig is more closely related to the wart-hog than to any other genus and is not to be considered intermediate between the latter and the bush pig, or *Sus*, as has been suggested by some naturalists. It is in reality quite a specialized animal, as shown by the peculiar shape of the

parietal portion of the skull, but its relationships are best expressed if considered a forest wart-hog. The characters which ally it to the wart-hog are the similarity in shape of the enlarged upper canines, which turn upward and inward and have only their lower basal parts in contact with the sharp cutting edges of the lower canines, the presence of only two upper incisor teeth, and well-developed pits or choanæ in the basisphenoid bone. The external similarity consists of an enlarged wart below the eye, a patch of horizontal whiskers on the cheek, and the presence of but two pairs of mammæ in the female. The cheek teeth have the ridged structure and shape found in the bush pig, but the general shape of the skull, especially the enlarged zygomatic arches, are distinctly like those of the wart-hog. In general external appearance the forest hog suggests a large edition of the bush pig, having the same relative proportion of head to bulk of body, short, stout legs, long tufted tail, pointed pencillate ears, and a uniform covering of coarse hair throughout. In bulk of body it exceeds somewhat any other pig, but in standing height at the withers it is slightly inferior to the larger Asiatic boars, such as the long-headed Bornean species.

Although the forest hog eluded discovery until 1904, the veil which had shrouded it was lifted in a remarkable manner throughout Africa during the succeeding few years, within which time three additional new species, or rather races, were described from the Cameroons and the headwaters of the Congo River. Our knowledge of the forest hog may be said to have sprung into existence almost simultaneously from remote parts of Africa. Two years after the discovery of the first specimen we are confronted with descriptions of two additional species or races of this rare animal from localities many hundreds of miles from the original source. Three years later still another was described from the Congo basin. Specimens at the present time are not at all rare in the principal natural history museums of Europe and America. It is, indeed, remarkable to find an animal so exceedingly rare and of such recent discovery so completely illuminated within so few years of its discovery, while many long-known species, such as the Derby eland, West African bongo, Abbott duiker, and a

host of other long-known species, remain quite unrepresented in museum collections.

Hylochœrus is now known to be distributed from the forested highlands of British East Africa westward throughout the Congo watershed, to within close proximity of the Atlantic coast of Africa. The forest hog has a great altitudinal range, being distributed throughout the forest area quite to its upper limits. In addition to the type species, *minertzhageni*, three others have been described, all within the Congo basin, but none of these really show specific distinctions, but are based on individual differences in the skull structure. They represent a single Congo race, without doubt, which is separable from the East African race only by slight relative differences in dentition, as pointed out by Thomas for the Cameroons race, *rimator*.

East African Forest Hog

Hylochœrus minertzhageni

Native Names: Nandi, *tumtu;* Tiriki (Kakumega forest), *mbirri;* Masai, *elguya;* Kikuyu, *numera.*

Hylochœrus minertzhageni Thomas, 1904, Proc. Zool. Soc., p. 196.

Range.—Forested regions of Mount Kenia, Aberdare Range, Kikuyu and Mau Escarpments westward as far as Mount Elgon and eastern Uganda.

The type species of the recently discovered forest hog has been named by Thomas *minertzhageni*, for its discoverer. Minertzhagen, however, did not actually meet the species which bears his name in a wild state, but obtained his specimens, as he has recorded, from natives and from some American missionaries resident on the borders of the Kakumega forest. He refers to one of these missionaries as having actually shot a forest pig, and this is apparently the first recorded instance of such a feat by a white man. The man referred to in these remarks is without doubt Doctor E. Blackburn, the medical officer of the Friends Africa Industrial Mission, who has long been a resident of the mission station of Kaimosi, and through whom were obtained the original skulls of the forest hog sent by Minertzhagen to the British Museum. Very few white

men have thus far succeeded in bagging the forest hog, most of the specimens recorded having been obtained from the Wandorobo bushmen, who catch them occasionally in their game pits. Recently the American Museum of Natural History of New York has received a fine adult pair from an American hunter, Alfred J. Klein, who shot the specimens himself near Escarpment Station, in the dense forest clothing the summit of the Kikuyu Escarpment. The National Museum collection contains two complete specimens of adult boars, one a gift to Colonel Roosevelt from Lord Delamere, and the other obtained by purchase from a farmer resident at Lake Naivasha.

The coloration of these specimens is a uniform black with the exception of some inconspicuous patches of pale-buffy or whitish hair on the sides of the snout, near the angle of the mouth, on the cheeks below the wart, on the inner side of the ears, and on the belly. The hair covering is quite uniform, without any tendency toward a dorsal mane, but rather scanty, the skin showing through the coat. Upon the cheeks below the wart are a row of horizontally directed whiskers, as in the wart-hog, but they are much less conspicuous, not being differentiated by lighter color, but having a few whitish hairs mixed with the black ones. A mounted specimen of the Cameroons race, *rimator*, in the National Museum is quite identical in coloration with the specimens from British East Africa, the whitish areas on the sides of the head agreeing in area and inconspicuousness. No sexual differences are apparent among forest hogs, but the wart below the eye is smaller in the females. The color of the newly born young is not known, but it is doubtless a uniform deep-brown, as in the young of the closely allied wart-hog. No flesh measurements of any specimens are recorded in the literature, the known specimens consisting chiefly of skulls or skins obtained from natives. The skin of the specimen received from Lord Delamere, which is the larger of the two in the National Museum, measures in a tanned condition: head and body, 59 inches; tail, 13 inches; hind foot, 10 inches; ear, 4¼ inches. The skull of this specimen, which is fully adult and shows wear on the last molar tooth has a length of 16⅝ inches, which is slightly less than the largest wart-hog skull from East Africa. A specimen from

the upper altitudes of the Kenia forest, recorded by Lönnberg, is considerably greater than any known wart-hog skull, being 18¼ inches in length. Adult female skulls are smaller than those of the males, averaging about 15¾ inches in greatest length. The tusks or upper canine teeth of the forest hog do not show such great development as takes place in the wart-hog. The larger of the two boars in the National Museum has an exposed length of tusk of 5¾ inches. Ward records two specimens from Mount Kenia in which the exposed portions of the tusks measure 8½ and 7½ inches, respectively. The former of these may be taken as the record tusk length.

Mount Kenia is the farthest eastern point at which forest hogs have been collected, there being yet no evidence of their occurrence in the extensive forests of Mount Kilimanjaro. On Kenia they are known to occur from the lower edges of the forest, at four thousand feet, to its upper limits, at ten thousand feet, where the vegetable growth is chiefly giant bamboo. At this extreme upper limit Akeley has noted extensive areas rooted up by forest hogs, and in places the uprooted vegetation, consisting of herbs and grass, massed into small mounds like haycocks. In places where the forest hog is abundant definite paths are made through the undershrubs of the forest, and where the growth is dense veritable tunnels are formed. They are much more strictly confined to the forest than the bush pigs, and never leave it to make forages into native fields, or shambas. Like the wart-hog, they are much less gregarious in habits than the bush pig, often living a solitary life. Specimens have been secured by sportsmen and naturalists on the northeast, southeast, and southwest slopes of Mount Kenia; on the Aberdare Range in the vicinity of Nyeri Hill; on the summit of the Kikuyu Escarpment; in the Mau forest near Enjoro and on its summit at Molo; in the Nandi reserve, at the base of the Mau Escarpment in the Kakumega forest, near the shores of the Victoria Nyanza; and on the slopes of Mount Elgon.

Wart-Hogs

Phacochœrus

Phacochœrus G. Cuvier, 1817, Reg. Anim., I, p. 236; type *P. æthiopicus* of the Cape region.

The wart-hogs are highly specialized members of the pig family and differ strikingly from such typical members as the wild boar and the bush pig. The two pairs of large warts on the face and the enlarged upwardly curved canine teeth at once distinguish them from all other genera. The warts are dermal structures and receive no bony or muscular support, but are made up of a solid accumulation of gristle or cartilaginous material. Upon the cheek there occurs a long, ridge-like fold extending toward the angle of the mouth upon which grow the conspicuous horizontally directed white whiskers. This structure is sometimes considered a wart and has given rise to the statement that three pairs of warts are present. The upper canines turn upward in a great semicircle and only the lower side of their bases comes in contact with the lower canines to form a cutting surface. The latter teeth are long and slender, triangular in shape with sharp edges, and are very formidable weapons, in marked contrast to the blunt upper canines, which are quite useless for defence on account of their turned-in points and circular shape. The cheek-teeth also show decided peculiarity, their surfaces being flat without transverse ridges and composed of a number of rounded tubercles of enamel and dentine irregularly arranged, which, when worn, give the surface of the tooth the appearance of a cluster of islands of enamel held together by cement. The last molar attains enormous development in age, when it occupies three-fourths of the tooth row and in extreme age becomes the only functional tooth. The head of the wart-hog is enormously enlarged, the skull of a fully adult male being quite equal in size to that of a giant forest pig, an animal having a bulk of body quite twice that of the wart-hog. The body is round and barrel-shaped, supported on short legs and quite nude in general appearance. The hair covering consists of a long, thin mane of coarse hair from the nape to the middle of the back, where it is broken

by a bare interspace but continued again on the rump. The hair covering of the sides, under-parts, and legs is very short and sparse, the individual hairs being separated by interspaces of half an inch or more. The tail is slender and quite naked with a tuft of black hair at the extreme tip. The female lacks the warts of the male with the exception of a small rudiment below the eye and the ridge of whiskers on the cheek, has much smaller upper incisors and smaller body size, but shows no differences in coloration or hair covering. The mammæ are only four. The young differ from those of other wild hogs by being uniform in color without lighter stripes or spots. The wart-hogs are confined at the present time in their distribution to Africa, to which region they appear always to have been limited; for no trace of them has been discovered in the fossil-bearing beds of Europe and Asia. Two Pleistocene species are known from the extreme points of the African continent, one from the Cape region and the other from Algeria. Three distinct species may be distinguished by differences in dentition and shape of skull. Two of these species lack both upper and lower incisor teeth and occur widely separated from one another; one, *æthiopicus*, at the Cape of Good Hope, and the other, *delamerei*, in the desert region of East Africa and Somaliland. The other species, to which the name *africanus* has been given, occupies the intermediate territory from Natal northward to Abyssinia and westward to Senegal. This species has two well-developed upper incisor teeth and either four or six lower ones. Several geographical races of this species may be recognized which are based on differences in skull shape. It is this wide-spread species alone which is familiar to sportsmen, the Cape, *æthiopicus*, being now doubtless extinct and the northern one, *delamerei*, being quite rare in the region of its occurrence.

Wart-hogs were common on the bare plains of East Africa, and they occasionally went among the thin groves of thorn-trees. We found them in the Lado. They were never found in thick forest. When persecuted by man they

became nocturnal; but we often saw them abroad at midday, although their favorite times for roaming and feeding were in the morning and afternoon. They frequently rooted up the ground, going down on their knees; but even more frequently they cropped grass like a zebra or hartebeest. Their food is purely vegetable. They live in burrows, which they invariably enter backward, so as to present to any enemy a front of teeth which would daunt the most ferocious. No matter how headlong the speed of a hunted pig it will always turn and slip backward into its hole, with jack-in-the-box agility. Once we saw a young boar thus disappear, and immediately afterward reappear as if shot out of a catapult; evidently the burrow was already inhabited by another pig, which had savagely assailed the hind quarters of the intruder. When close pressed they will charge valiantly; but they are certainly nothing like as savage as peccaries. We found a sow with very young pigs in November on the Uasin Gishu; but apparently they breed at all seasons. In galloping after a boar we noticed that in trying to look back at his pursuer he lifted his snout, not turning his head to one side. When in motion wart-hogs always carry the tail straight up, the tassel perhaps falling forward. They are easily tamed, and make amusing pets owing to their continuous grotesque starts and grunts. They often become exceedingly attached to their owners. At the McMillans' place the cheetahs and wart-hogs were as safe companions as the gazelles; whereas nobody could touch the leopards; and elsewhere we found that the zebras and hartebeests were apt to be dangerous when they became tame.

KEY TO THE SPECIES AND RACES OF *Phacochœrus*

Incisor teeth present in both jaws and functional; warts conical
africanus

Postorbital portion of the skull short and narrow, one-tenth the length of the skull; interorbital region concave
africanus æliani

Postorbital portion of the skull long and broad, one-eighth the length of the skull; interorbital region flat
africanus bufo

Incisor teeth completely absent in the upper jaw and present in the lower only as vestiges below the gums; warts knobbed at the apex *delamerei*

EAST AFRICAN WART-HOG

Phacochœrus africanus æliani

NATIVE NAMES: Swahili, *ngili;* Kavirondo, *mbithi;* Abyssinian, *kurkerrow.*
Phacochœrus æliani Cretzschmar, 1826, Rüppell's "Atlas," p. 61.

RANGE.—From the highlands of Abyssinia southward through Uganda and British East Africa to German East Africa.

The East African wart-hog was first described from specimens collected in Abyssinia in 1826 by the renowned traveller Rüppell. Every traveller and explorer who has entered equatorial Africa from the days of Speke and Grant down to the present has met with the wart-hog. The East African race differs in no way, externally, from the Nile or the Senegambian races, but may be distinguished by the greater narrowness and shortness of that portion of the skull projecting behind the orbits. The length of this projecting part is usually about one-tenth the whole length of the skull. The wart-hog of East Africa is uniform blackish in appearance, due to the dark color of the skin and the scantiness of the hair covering. Along the crest of the back from the nape to the middle of the back, extends a thin mane of long, black hair, which hangs down on the sides in loose strands. The middle part of the back for a distance of some

six or eight inches is bare, but the rump is clothed scantily by black hair similar to that of the neck mane. The sides of the body, under-parts, and legs are clothed by short, whitish hair set about one-half inch apart and having scarcely any perceptible color effect on the dark skin. The front of the legs from the knee downward support a growth of longer, denser, blackish hair, but the knees themselves are quite bare and calloused from kneeling. The tail is quite naked, with the exception of the tip, which is furnished by a tuft of stiff, black hair. The head has a conspicuous growth of white whiskers, running from below the eye to the mouth, which stand out stiffly at right angles to the cheeks, owing to their insertion on a narrow, shelf-like wart. The top of the head, snout, and lips are clothed by a scattered growth of short, black hair, while the lower part of the cheeks and throat show a somewhat scantier and shorter growth of whitish hair. The short, rounded ears are thinly covered by black hair on the back and by long white hair on the inner side. The newly born young are a uniform umber-brown, but soon lose this first pelage. When half grown they are quite like the adults in color and have the white cheek whiskers well developed.

The flesh measurements of a large male from the Loita Plains were: head and body, 56 inches; tail, 17 inches; hind foot, 11 inches; ear, 5¼ inches. An average female measures some 12 inches less in length and 1 inch less in length of foot than these dimensions. Males range in greatest length of skull from 15¼ to 17 inches and females from 13 to 14 inches. The tusks average in males, in exposed length measured on the curve, 9 inches. The longest tusk in the National Museum in a series of twenty-five adults is a specimen from the Kedong Valley, near Kijabe, measuring 13½ inches and exceeding Ward's record for East Africa by 1 inch. Female tusks average 6 inches on the curve. The longest in the National Museum is one from the Loita Plains having a length of 9¼ inches. A series of fifty specimens have been examined in the National Museum from the Loita, Athi, and Kapiti Plains, Kedong Valley, Uasin Gishu and Laikipia Plateaux, and Taveta, British East Africa. The altitudinal range of the wart-hog seldom or never exceeds eight thousand feet. It

is most plentiful on the highlands between three thousand and seven thousand feet, on the edges of the plains country, or in scattered bush. It is rare in the low desert nyikae of the coast slope.

Nile Wart-Hog

Phacochœrus africanus bufo

Native Names: Dinka, *dyehr;* Bongo, *bohdoos;* Niam-niam, *tibba.*

Phacochœrus africanus bufo Heller, 1913, Smith. Misc. Coll., Vol. 61, No. 22, p. 2.

Range.—Nile Valley from the Albert Nyanza northward to the Bahr-el-Ghazal and Sobat Rivers; limits of range unknown.

The Nile wart-hog has been recently separated as a new race on the evidence of a skull collected by the Smithsonian African expedition at Rhino Camp in the Lado Enclave. The type specimen was collected on the shores of a small pond near Chief Sururu's village in the vicinity of Rhino Camp. The wart-hog had been killed by a lion the night previous to our arrival and the head was the only portion which remained uneaten. Wart-hogs were rare in the Lado Enclave, less than a score being seen by the members of the Smithsonian African expedition during a month's sojourn in the upper Nile district. In addition to those observed at Rhino Camp a few were seen in the vicinity of a small lake near Gondokoro.

The Nile wart-hog differs from *æliani* of Abyssinia and East Africa by the greater breadth and length of the postorbital or parietal portion of the skull and the flatter interorbital region. Other minor differences from *æliani* are the absence of elevation of the parietal or lambdoidal crests, which are on the same level as the interorbital region, the narrowness of the choanæ posteriorly, and the smaller size of the tympanic bullæ. The type is unfortunately an immature skull in which the last molar is just erupting and with all the maxillary sutures still evident. Skulls of this age from the highlands of British East Africa show a much narrower, shorter, and more elevated parietal region. In the flatness of the interorbital region and in the general shape of the postorbital part of the skull the type resem-

bles the skull of *Phacochœrus delamerei* closely, but differs from that species, as do all the *africanus* group, by the presence of well-developed upper and lower incisors and roofed-over choanæ. The skull has a length of 14¾ inches, which is large for an immature female specimen and would indicate a larger body size for this race than that of the East African. The tusks are small, owing to the immaturity of the individual, the exposed portion of the tusks being only 3½ inches. The longest Soudan specimen recorded by Ward is one having tusks 11¼ inches for the same measurement.

Desert Wart-Hog

Phacochœrus delamerei

Native Name: Somali, *dofar*.
Phacochœrus delamerei Lönnberg, 1908, Proc. Zool. Soc., p. 940.

Range.—Low desert or nyika region of the Northern Guaso Nyiro River northward to Somaliland and westward to Lake Rudolf.

The desert wart-hog has long remained unknown or undescribed, although specimens have for many years been shot by sportsmen to whom the region which they inhabit is well known. In 1908 Lönnberg discovered two skulls at the British Museum, collected by Lord Delamere somewhere in the desert region between Somaliland and the Northern Guaso Nyiro of British East Africa, which differed strikingly by the absence of incisor teeth and the shortness or greater breadth of the skull from those of the ordinary or *africanus* type of wart-hog. In these characters they agreed with *æthiopicus*, a species confined to the extreme southern point of Africa and now doubtless extinct. We have thus among wart-hogs a peculiar condition of distribution, not duplicated by other game mammals, consisting of two species, closely allied, living at opposite extremes of the range of the genus with the intermediate territory occupied by a distantly related species showing considerably less specialization. The desert wart-hog must be considered one of the most highly specialized wart-hogs, owing to the reduction or loss of its incisors, great breadth of skull, and the enlarged and knobbed character of its warts. The absence of the

upper incisors is not a recent affair but one which has been long established, as shown by the absence of even rudimentary incisors in young a few months of age. The lower incisor teeth show less complete disappearance and still persist as rudiments sunk beneath the rim of the bone in pits well below the gums. These teeth are quite as rudimentary and functionless in the young as in the adults. Other skull differences are the absence of a bony roof over the posterior part of the choanæ or pits in the floor of the skull.

Two specimens of the desert wart-hog are in the National Museum, collected by the Rainey expedition in the region lying between Mount Marsabit and the Northern Guaso Nyiro. One of these is an adult male but not an old animal, the last molar not being fully in place and the upper tusks only half grown. The flesh measurements and skull of this specimen are considerably less in size than those of the East African wart-hog, as are also those of an adult female recorded by Lönnberg, which would indicate much smaller body size for this species. The flesh measurements of the male were: head and body, 42 inches; tail, 17½ inches; hind foot, 9½ inches; ear, 4¾ inches. Greatest length of skull: male, 13⅜ inches; female, 12¾ inches. Exposed portion of upper tusk in the male measured on the curve, 5¾ inches. Ward records specimens from Somaliland having a length of exposed tusks ranging from 10 to 13 inches, but such specimens may be referable to *africanus*, which occurs in the highlands of Somaliland and Abyssinia in close proximity to *delamerei*. The desert wart-hog is found only in the lower drainage area of the Northern Guaso Nyiro below an altitude of three thousand feet, the river drainage above this altitude and the slopes of Mount Kenia and the Aberdare Range being occupied by the East African wart-hog. It extends southward, no doubt, as far as the north bank of the Tana River. Sportsmen's records regarding this species, however, are wanting, owing to its confusion by them with the East African race, which it resembles closely in general external appearance.

CHAPTER X

THE HIPPOPOTAMUS

Hippopotamuses

Family *Hippopotamidæ*

The members of the family *Hippopotamidæ* are perhaps best described as hairless, thick-skinned mammals of large size related to the pigs. They are, however, only distantly related to pigs, from which they differ in many fundamental ways, chief of which are the primitive condition or evenly four-toed character of the feet, the lateral toes of which reach the ground and assist in supporting the body weight. The head differs decidedly from that of the pigs by the absence of a terminal disk to the snout and by the enormous enlargement of the lower jaw. The canines are developed into large tusks, the tips of which come in contact inside of the lips. The incisor teeth grow into long spikes, which do not meet or function as grass-cutters, the great square lips with their horny edges performing the work of grazing. The molar teeth are transversely ridged and small, the last one showing no tendency toward the lengthening and complication found in the pigs. The body is long and barrel-shaped, and supported on very short legs placed far apart, making locomotion slow. The head is very peculiar, being quite square in front, flat on top, with an enormous mouth and lower jaw of immense proportions. Placed rather high and near

the corners of the muzzle are the elongated nostrils. The eyes are small, pig-like, and mounted on the upper surface of the head. Behind them, a short way, project the diminutive rounded ears. The only parts of the body which show a growth of hair are the tip of the short tail, the inside of the ears, and the muzzle from the nostrils to the lips. There are at the present time two living genera, both confined to Africa—the gigantic river hippopotamus, *Hippopotamus*, and the pygmy or forest hippopotamus, *Chæropsis*. The latter genus differs from its gigantic relative, in addition to its smaller size, by its much longer and more slender legs, more laterally placed orbits, more circular nostrils, longer tail, a lesser number of incisor teeth, and much larger brain and a correspondingly larger brain-case in the skull. The pygmy hippopotamus spends most of its time on land in the thick forest growth, to which it retreats when alarmed. The lateral position of the eyes and the circular nostrils are differences in structure which do not fit it for an aquatic life such as is passed by the larger genus. Hippopotamuses of both genera were abundant in the Pliocene and Pleistocene age in Europe, Asia, and North Africa. Fossil species allied to the pygmy hippopotamus are known from the larger islands of the Mediterranean and from Madagascar, in which latter island they were the only ungulate and practically the only land animal showing African affinities, with the doubtful exception of the bush pig, whose status as a native mammal is questionable.

KEY TO THE RACES OF *amphibius*

Nasal bones narrow, their least width less than 1¼ inches; upper rim of orbit less elevated, reaching at most 1½ inches

above level of crown of skull; rostral constriction greater, five and one-half times or more in skull length; body size greater *amphibius*

Nasal bones wide, their least width greater than 1½ inches; upper rim of orbit elevated 1⅜ inches or more above level of crown of skull; rostral constriction less, averaging five times in skull length; body size less *kiboko*

HIPPOPOTAMUS

Hippopotamus

Hippopotamus Linnæus, 1758, Systema Naturæ, I, p. 74; type *H. amphibius*.

The hippopotamus is one of the very oldest known mammals in literature, and is found referred to in some of the most ancient Egyptian writings. It was well known to the ancient civilizations of the Mediterranean basin, and several myths regarding its peculiar habit of sweating blood are found in Greek literature. Notwithstanding the ancient and well-known character of the hippopotamus, it remains without an English name and is everywhere known in our literature by the scientific generic term proposed by Linnæus in 1758. To the Dutch colonists of South Africa it was known as the zee koe or lake cow, a term later corrupted to sea cow by the English colonists. The Germans have bestowed upon it the name of river horse, owing to the fancied resemblance of the crown of the head, as seen in a floating animal, to that of a horse. A far more appropriate term, considering its zoological affinities, is that of river pig, applied to it by the ancient Egyptians.

The aquatic habits of the hippopotamus have favored its development to an enormous bulk, just as in the case of some of the seals. An adult bull attains a weight of approximately four tons and is quite equal to a cow elephant in bulk. Record bulls no doubt reach a weight of five tons and are only exceeded in bulk among land mammals by the bull elephant. From the pygmy hippopotamus the true hippopotamus differs by its great superiority in size, the shorter legs, shorter tail, which is a mere rudiment and is much compressed laterally, the prominent dorsally situ-

ated eyes, and small brain. The sexual differences in hippopotamuses consist of greater body size, larger canine teeth, and heavier or more bristle-like hair in the tail tuft in the bull. The difference in the diameter of the canine teeth is so great that skulls can be as readily sexed by the size of the sockets of the tusks as by the teeth themselves. A large number of fossil species of gigantic hippopotamuses are known from the Pliocene and more recent Pleistocene formations of southern Europe, India, Sumatra, Java, and the Mediterranean coast of Africa. Some of these species are scarcely distinguishable by their skull structure from the living *amphibius* of Africa. Remains of one of these closely allied species of *amphibius* have been found on the present site of London. Some of the older species of hippopotamuses of the Pliocene have been separated as a distinct genus owing to the presence of the full number of incisor teeth in distinction to the four which characterize the living genus *Hippopotamus*. Within modern historic times the hippopotamus occurred much more widely distributed than at the present time. Formerly they were found the entire length of the Nile to its delta, but to-day they are absent from the Nile proper north of Khartoum and occur only in its headwaters and tributary streams. At the present time they are greatly diminished in numbers in South Africa, being quite extinct from the Cape district south of the Orange River. They exist to-day, south of the Zambesi, only in a few rivers where they have been afforded strict protection. In equatorial or central Africa they are still abundant from Abyssinia and Senegal south to the Zambesi watershed wherever there are rivers or lakes with sufficient water or swamp vegetation to give them cover. A single living species is known, *amphibius*, to which several racial or subspecific names have been applied, the earlier of these dating back nearly one hundred years. Racial distinctions have, however, in no case been well established, owing to the small number of specimens preserved in museums and the great individual variation shown by the skulls upon which differences alone have been founded. It is, however, now apparent that there are not only skull differences but slight differences in the body coloration and size as well, which are of a geographical character, and

further study will no doubt reveal characters by which several races may be recognized of this wide-spread species.

The hippo often wanders far overland at night, and doubtless thus wandered by day in the past ages before man became the most formidable foe of all big creatures. In consequence it is found in some land-locked waters, like Lake Naivasha, to which it can only have penetrated by extensive journeys across country containing no streams in which it could swim or hide itself. Where human beings are rare and relatively inoffensive, it is often found in streams so small that it seems extraordinary that so bulky a creature can dwell in them without being always in evidence; but in such streams it always finds some pool or quiet reach with a fringe of reeds or bush that offers it a chance to hide during the daytime. Where much molested it becomes excessively shy, and during daylight often lies for hours with only its nostrils above water, in the shelter of some tuft of water-grass or the like; and under such circumstances it is astonishingly hard to make out. But on the Nile, among the channels and shallows of the vast beds of papyrus, we frequently saw small herds or family parties of the obese, unwieldly creatures sunning themselves even at noon, half out of water, or out on the shore, with their heads resting on the mud or on one another's bodies. Biting flies hover over them, and instead of the ticks which infest the elephant and rhino the hippos are hosts of small leeches which are often found in swarms fixed to the more tender parts. Not only have we seen herons and plover walking about and over them, but also birds that looked like tick-birds.

We frequently found single hippo dwelling in tiny pools, usually surrounded by marsh, miles away from the nearest lake or river, and sometimes so high among the hills that the animals must have done some real climbing to get to them. On one occasion while on the Uasin Gishu we were camped by a reed-covered marsh with very little open water in it; we had no idea there was a hippo anywhere near; but when some of the men went to get water, after nightfall, they were threatened and thoroughly frightened by a hippo, and when we white men turned out to see what had happened, we could hear the hippo in the darkness snorting and gambolling heavily about us, as we walked through the wet meadow of short grass. At night they were always very bold, and on their rambles came close to camp; or, if we were in boats, they would snort and plunge as they examined us with fearless curiosity close alongside. On the Nile there were masses of a little surface-floating plant which we called water-cabbage, *Pistia stratoides*. Evidently when the hippos went ashore for a nocturnal walk they carried these plants with them, supposedly on their backs; for in the morning we would sometimes find them drying in the hot sun miles inland. In spite of their clumsy build hippos trot and gallop fast. Their feet are kept far apart by the wide body and make paths with a ridge down the middle, so as to be recognizable at once. They swim well, but go at their greatest speed when they can gallop along the bottom in shallow water. They can stay under water a long time, and when they come to the surface they may send little jets of spray from their nostrils. We were puzzled by the noises they made. Occasionally at night we heard them roar, in a way that we thought must be done

with the open mouth; but the ordinary sound was more like the exhaust of a steam-engine and we think it was made through the nostrils. At night they made all kinds of noises while in the water, and when on the bank; but we never heard them utter a sound when far inland on their rambles. In the daytime we once heard one uttering a series of meditative bubbling squeaks from its secure fastness behind the green wall of plumed papyrus.

The cow is devoted to the calf. When young it stands on her back as she swims. We do not understand the unconcern with which the hippos and crocodiles get on, for some of the latter are certainly large enough and greedy enough to kill a partly grown hippo. Probably the crocodiles dread the vengeance of the truculent old bulls and cows. They feast greedily on a hippo carcass; but so they will on the carcass of one of their own number. The hippo bulls fight savagely among themselves, and at times a ruthless old bully will maul other members of the herd. At Lake Naivasha a young bull which had been thus maltreated, and was badly scarred, must have gone slightly crazy in consequence, for he came on shore and attacked the cattle, and had to be slain.

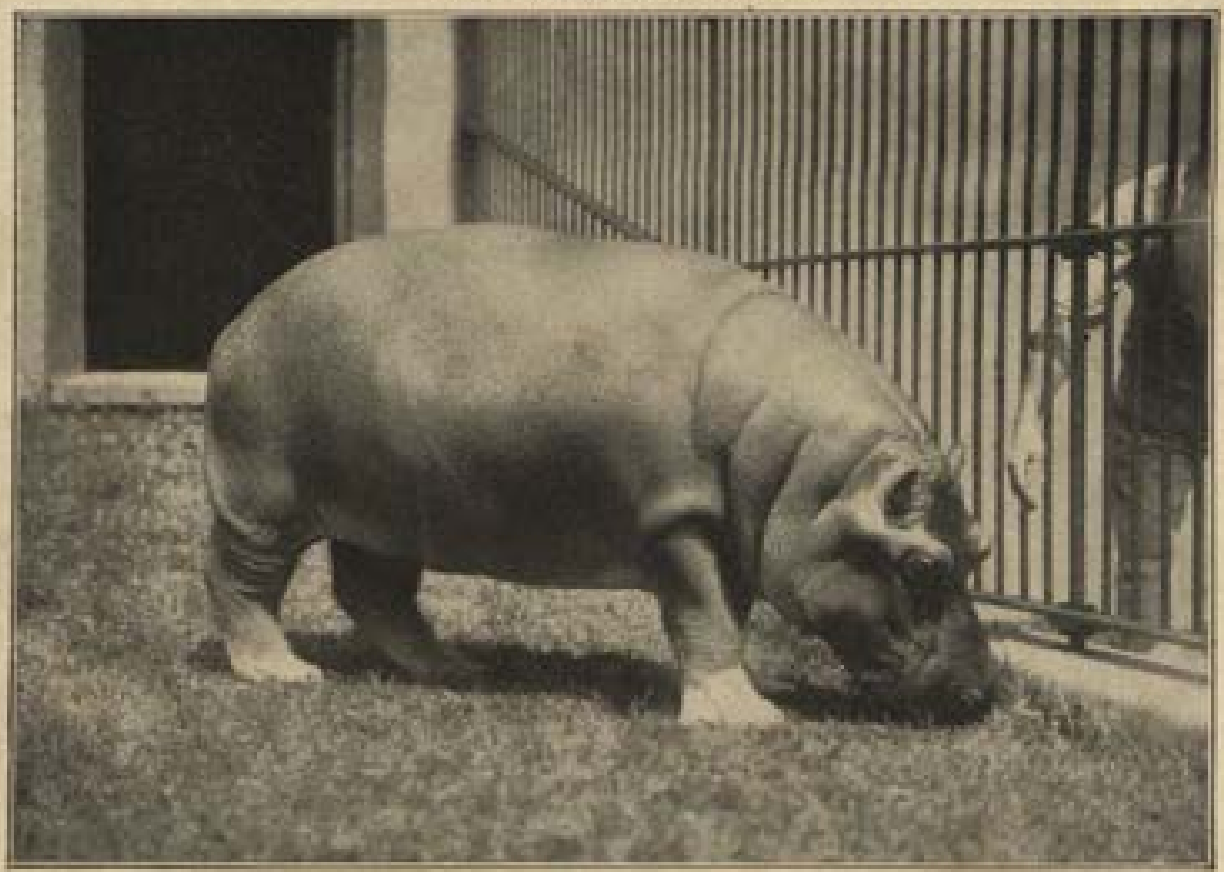
Where unmolested hippos become very insolent and not only ravage the gardens and fields but attack any one who interferes with them; and in places they attack and upset canoes, sometimes quite wantonly, sometimes because the assailant has been wounded or is a cow with a calf. After the canoe is upset they may wreck it with their huge jaws, and they may or may not assail the swimmers. In one case, in the Lado, an old native was almost bitten in two by a savage bull after his canoe was upset; and we were informed

by entirely trustworthy people that in swimming cattle across a river savage hippos had been known to assail and kill them, wholly without provocation. After we left Africa an English official we had met was upset in a canoe by a hippo and then carried off by a crocodile. Usually there is no sport in hippo shooting; it needs nothing but good marksmanship, and, as the brain is the target, accuracy and penetration are the only qualities demanded in the rifle. Ordinarily, from the circumstances of the case, there is not the slightest danger in hippo shooting; yet Colonel Roosevelt was once resolutely charged by a hippo which he shot in shallow water; with jaws open it came straight for the boat, which was between it and deep water. A wounded hippo will sometimes attack the boat of its assailant; and in rare cases an unusually truculent animal will charge out of the water and try to reach the hunter on land.

Hippos feed on land at night, as a rule, although we once saw two tearing up and eating water-lilies, or some plants that were among water-lilies, in the late afternoon. Naturally they find corn, beans, melons, and other garden products particularly attractive, and if they are plentiful will destroy the crops of all villages which lie along the water-front.

Once on the Nile while two of us were watching a monitor stealing crocodile's eggs we noticed a hippo in midstream. Although it was in the forenoon, when most hippos were resting, it appeared above water at about two-and-a-half-minute intervals, in the same place, breathed, and sank. This continued for an hour. The current was too rapid for him to rest; and it hardly seemed that he could be feeding on anything. We do not know what he was doing.

EAST AFRICAN HIPPOPOTAMUS
In the Tana River near Fort Hall, B. E. A.
From a photograph by Carl E. Akeley



NILE HIPPOPOTAMUS, FEMALE, FOUR YEARS OLD
From Victoria Nyanza
In the National Zoological Park, Washington, D. C.

LIVING SPECIMENS OF HIPPOPOTAMUSES

Nile Hippopotamus

Hippopotamus amphibius amphibius

Native Names: Luganda, *emvubu;* Dinka, *nyang;* Bongo, *habba;* Abyssinian, *gumari.*

Hippopotamus amphibius Linnæus, 1858, Systema Naturæ, p. 74.

Range.—Nile watershed from the Victoria and Edward Nyanzas northward to the limits of the grass-land on the White Nile as far as Kaka, and eastward through the Abyssinian highlands drained by the Nile tributaries.

The hippopotamus was first known to Europeans from the Nile, and it is to this region that we must refer the original species described by Linnæus. If we regard the species as separable into several geographical races, then the Nile race must stand as the typical one. Specimens from the Nile watershed are distinguishable from those of East Africa by the narrower nasal bones, the less elevated orbits and the greater rostral constriction of the skull, and the larger body size. At the present time there are no skins of Nile specimens available for comparison with East African skins, and the color and other external characters cannot be determined. Every traveller who has entered the upper regions of the Nile watershed has met with this animal and has, with few exceptions, given accounts of his experiences with these aquatic monsters. The flesh forms a valuable article of food to exploring caravans or safaris, and the quest of the hippopotamus has been more or less of a necessity to the leaders of such parties. Owing to the great bulk of the head, comparatively few specimens of skulls have reached Europe, usually the only parts retained as trophies being the large lower canine teeth. The Nile hippopotamus, therefore, has yet to become well known in a detailed way as regards the variation of its structure. The Nile race of the hippopotamus attains a large body size, judging from the dimensions of a male skull in the British Museum, which has a length of 30 inches and exceeds any other skull known to the writers. A female skull from the Lado Enclave collected by Major Powell-Cotton shows a correspondingly large size, measuring 26½ inches in length. In contrast

to these dimensions the largest British East African skulls are: male, 28⅜ inches, female 25½ inches. Specimens of the skulls of the Nile hippopotamus have been examined from the Victoria Nyanza, White Nile, Lado Enclave, Blue Nile, and Atbara River. On the White Nile hippopotamuses were observed as far north as Jebelein, 13 degrees north latitude, by the members of the Roosevelt expedition in 1910. This point is well beyond the sudd area, where the conditions are quite arid and the desert margins of the river at this point form a natural barrier to the northward extension of the hippopotamus. Farther northward and eastward they occur in the upper waters of all the tributaries of the Nile having their sources in the Abyssinian highlands.

East African Hippopotamus

Hippopotamus amphibius kiboko

Native Names: Swahili, *kiboko;* Kikuyu, *nguo;* Masai, *olmakau.*

Hippopotamus amphibius kiboko Heller, 1913, Smith. Misc. Coll., Vol. 61, No. 22, p. 1.

Range.—From the Rift Valley of East Africa eastward to the seacoast, north as far as southern Abyssinia, and southward through German East Africa; limits of range not known.

A series of five specimens of hippopotamus shot by Colonel Roosevelt at Lake Naivasha are in the National Museum. The skulls of these specimens show such constant differences from Nile specimens that they have been recently recognized as a new race by Heller. This new East African race is characterized by the wide nasal bones, great elevation of the orbits, and the lambdoidal crest above the interorbital region, which has a deeply concave surface in consequence, and the less constriction of the rostral part of the skull. From typical *amphibius* of the Nile it is further distinguishable by its smaller body size and smaller canine teeth. It may be distinguished from *capensis* of South Africa and the Zambesi River system by its more circular orbit, the lighter body coloration, and the more heavily haired ears and tail tuft.

The color of the skin is grayish-olive and is deepest on the back and lightest on the under-parts, where it is in life a pinkish-drab on the belly, axillæ, and groins. The hair covering is absent except on the tip of the tail, the inside of the ears, and on the muzzle. The tail is furnished by a conspicuous tuft of seal-brown hair, four or five inches long, attached like a mane to the ridge of the flattened tip. The ears are heavily haired on the inside by olive-brown hair three-fourths of an inch in length, and the great lips at the muzzle, as far back as the nostrils, support a scattered growth of stiff buffy-brown tufts of hair placed at regular intervals apart, like the bristles of a scrub-brush.

The male skin from Naivasha differs from the three female skins, apart from its larger body size, by the much stiffer or bristle-like character of the tail tuft, which is also somewhat more extensive and lighter in color, being buffy-brown. The three females show much variation in the amount of tuft on the tail. In the Athi River specimen the terminal tuft is quite wanting, only a few short hairs one-half inch long being present. The lack of a definite tail tuft is no doubt due to the youth of the specimen, which is quite immature and has its milk teeth still in use. A living specimen from German East Africa, in the Washington Zoological Gardens, of about the same age is also without a definite tail tuft. The other two skins from Naivasha, which are fully adult, have the tail tuft composed of fairly soft chocolate-brown hair, the longest hairs having a length of 4½ inches.

The flesh measurements of the large male from Lake Naivasha, which has been made the type specimen of the race, were: head and body, 12 feet 2 inches; girth behind shoulders, 12 feet; tail, 20 inches; hind foot, 21½ inches; ear, 3¾ inches. The skull of this specimen measures 28⅜ inches. The largest adult female from the same locality measured in the flesh considerably less: head and body, 11 feet 2 inches; girth of body, 11 feet; tail, 15 inches; hind foot, 21 inches; ear, 3 inches. Length of skull, 25½ inches. The record circumference for lower canine teeth for British East Africa recorded by Ward is 7¼ inches, but this dimension is doubtless an inch or two below the real record for the region. The type bull from Naivasha, which is of

but average proportions, has the lower tusks 7 inches in diameter. Specimens of the East Africa race have been examined from Lakes Naivasha, Elmentaita, and Baringo of the Rift Valley, and from the Athi River of the coast drainage. The East African hippopotamus is most abundant in the upper course of the Tana River, from the vicinity of Fort Hall down as far as Karo-karo. The lower stretches of the river have been depleted of hippopotamus by the Wapokomo tribe, who hunt them for their flesh. They are, however, found in all the rivers having pools deep enough to afford them shelter, and are also found along the sea-coast in marshes. They occur everywhere in the desert, in lakes such as Lake Rudolf, and the Lorian Swamp, where the shore conditions are often quite arid. In British East Africa they occur on the high plateaux, in ponds or swamps, to a height of 8,000 feet at least. Only the highest mountain ranges seem to form barriers to their migration or dispersal.

CHAPTER XI

THE RETICULATED AND COMMON GIRAFFES

Giraffes

Giraffidæ

The living giraffes are so well separated by the character of their peculiar body shape and short, skin-covered horns from the other hoofed mammals that they have raised the family reputation for distinctness much beyond what it is really entitled to. The extinct or fossil members are less grotesque in shape and are less widely separated from the deer or stags in bodily proportions and other characters. One of the most remarkable of these was the gigantic *Sivatherium*, a genus having large, forked horns, a short neck, and general moose-like shape, but exceeding that animal greatly in bulk. A much less specialized animal than the giraffe is the recently discovered okapi, a forest-haunting, giraffe-like mammal having a rather short neck and a pair of short, giraffe-like horns. Notwithstanding the highly specialized character of the neck and limbs of the modern giraffe, the family is best characterized by its very primitive horn structure. The horns are not outgrowths of the bones of the skull, as in the deer and the antelopes, but they develop independently and in adult age become fused with both the frontal and parietal bones upon which they rest. They exhibit the primitive condition of being encased permanently by a covering of hair-bearing skin, and seem never to be of

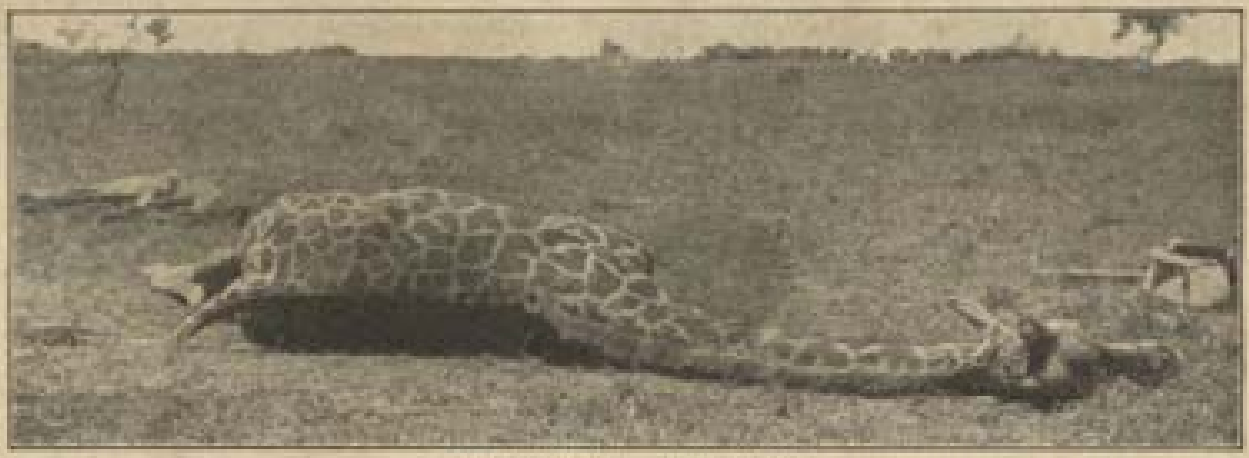
any functional value as weapons on account of their soft, skin-covered points, which show no wear. The adult giraffe horn is homologous to that of a deer horn in the "velvet," as it is composed of a bony core covered by soft, hair-bearing skin. The horns in the female are either lacking or much reduced in many of the genera. Some of the extinct genera, however, appear to have had harder and more sharply pointed horns of more formidable appearance than those of giraffes and okapis. The limbs show no trace of lateral toes or false hoofs, nor do they show hoof glands like most of the other ruminant families. The skull, beyond its horn structure, shows no other marked peculiarity, nor do the teeth show any substantial difference from those of deer with the exception of the broad, two-lobed character of the lower outer incisor or canine tooth. The family formerly had a much wider range than at present, and ranged throughout Asia and Europe from the Miocene on down to the Pleistocene age, reaching its maximum development in numbers in the Pliocene of Asia. To-day it occurs only in Africa, where it is represented by two genera—the well-known giraffe of the drier and more arid parts of the continent and the seclusive okapi of the Congo forests.

Giraffe

Giraffa

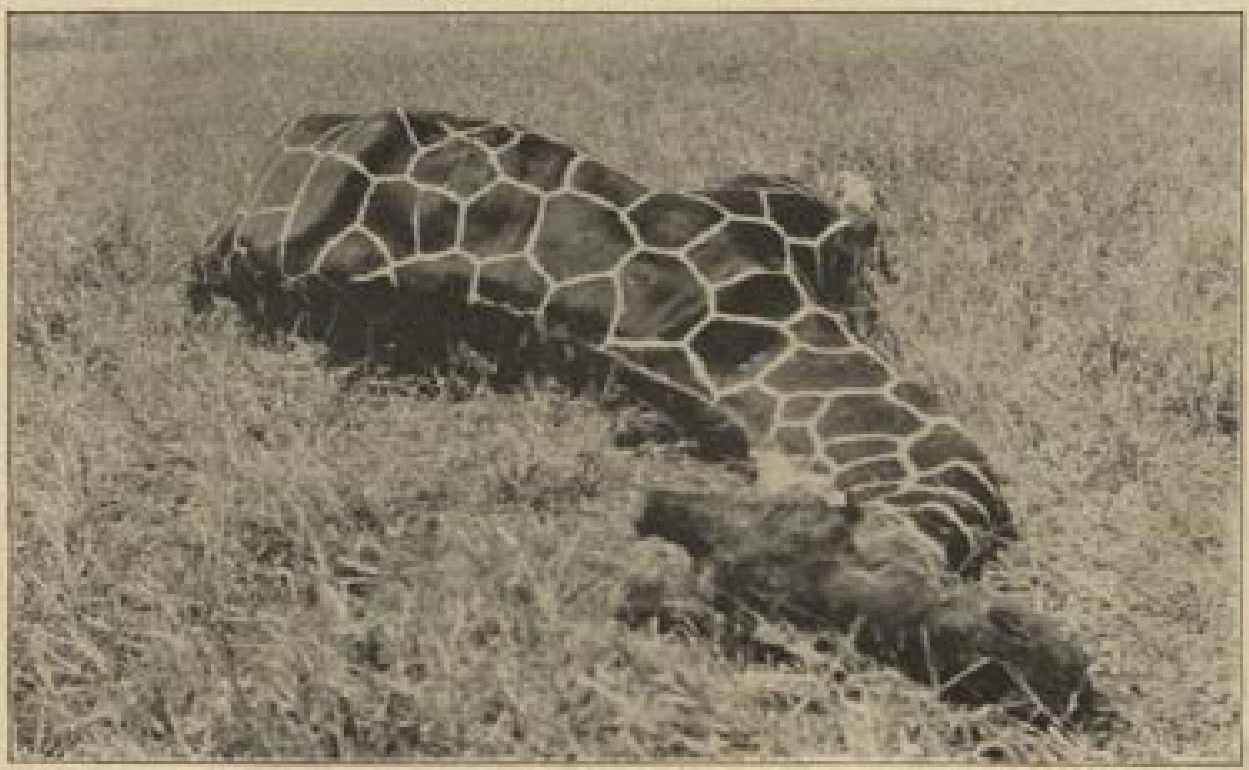
Giraffa Brisson, 1762, Reg. Anim., p. 60; type *G. camelopardalis*.

The word giraffe at once recalls to mind the picture of a large animal having an immense length of neck, tall, straight legs, a short body, small head, and blotched coloration. This grotesque animal stands as the extreme of his family in neck development and height of body, and, perversely enough,



MASAI GIRAFFE, ADULT MALE
Shot by Theodore Roosevelt, Kilima Kui

UGANDA GIRAFFE, ADULT MALE
Shot by Kermit Roosevelt, Uasin Gishu Plateau



RETICULATED GIRAFFE
Northern Guaso Nyiro
From a photograph by Theodore Roosevelt

THE RACES OF THE GIRAFFE

has been the only member capable of holding his place on the earth. His very grotesqueness and colossal size, no doubt, have been his salvation and have kept him aloof from close competition with the more modern hoofed mammals with which he shares the African continent. During Pliocene times he occurred farther afield, as shown by fossil remains from southern Europe and Asia, which region is generally believed to be his birthplace. To-day a single species is found in Africa, having a distribution throughout the whole continent south of the Sahara with the exception of the Congo forest area and the forested parts of the West Coast generally. The giraffe is the tallest of all mammals, large bulls not infrequently attaining a standing height of seventeen feet to the top of the horns. The usual height for bulls, however, ranges from fifteen to sixteen feet. The menagerie specimens, with which alone the public are familiar, are quite undersized and seldom exceed thirteen feet in height. Bulls are larger somewhat than the cows and are always decidedly heavier in build. The skull of the bull is much more massive and is exceedingly heavy, owing to the large size and dense nature of the horn growths at maturity. The upper lip projects far in advance of the lower and is somewhat prehensile, an adaptation commonly found in many browsing mammals. The sexes are alike in coloration, the old bulls not being consistently darker than the cows, as is so often stated. The nursing young are like their parents in pattern but are lighter colored, although half-grown, immature animals may be darker than the adults. The female has a single pair of mammæ and produces but one offspring at a birth. Several well-marked geographical races are recognizable by differences in coloration and horn development. There is little difference in body size or in general style of coloration, all of the giraffes being marked by large blotches of brown or red on a lighter ground-color which take the form of irregular reticulations. As we proceed from north to south the frontal horn decreases in size until finally, in the extreme southern race in South Africa, it disappears entirely, leaving the two lateral horns only. Some eight races may be recognized, although considerably more than this number have been described. At least three of these forms inhabit east

equatorial Africa, the diversified conditions of which country seem to be especially favorable for the development of differences in their coloration. A fourth race, *congoensis*, typically from the headwaters of the Welle River near the Nile watershed, may also be found within our area, but at the present time no specimens from the west side of the Nile are available for study in natural-history museums.

KEY TO RACES OF *camelopardalis*

Body marked by large blotches having even margins and separated by narrow reticulations of lighter color

Ground-color of neck white and forming very narrow reticulations between the large rufous blotches; sides of head and throat to chin also reticulated; legs reticulated and spotted below knee and hock; skull with frontal horn and mandible at coronoid process low; body size smaller *reticulata*

Ground-color of neck buff or ochraceous, not white; blotches tawny or seal-brown, but seldom rufous; sides of head and upper throat blotched; legs below knee and hock unspotted; frontal horn of skull very high; body size larger *rothschildi*

Body marked by small blotches having irregular or jagged margins; legs spotted below knees and hocks with small dark spots on an ochraceous or tawny ground-color; frontal horn of skull smaller *tippelskirchi*

RETICULATED GIRAFFE

Giraffa camelopardalis reticulata

NATIVE NAMES: Somali, *giri*; Abyssinian, *gerata*.

Giraffa camelopardalis reticulata De Winton, 1899, *Ann. & Mag. Nat. Hist.*, IV, p. 212.

RANGE.—Desert region from the northern slopes of Mount Kenia and the north bank of the Tana River northward to southern Abyssinia and west as far as the east shore of Lake Rudolf.

The reticulated giraffe was described by De Winton

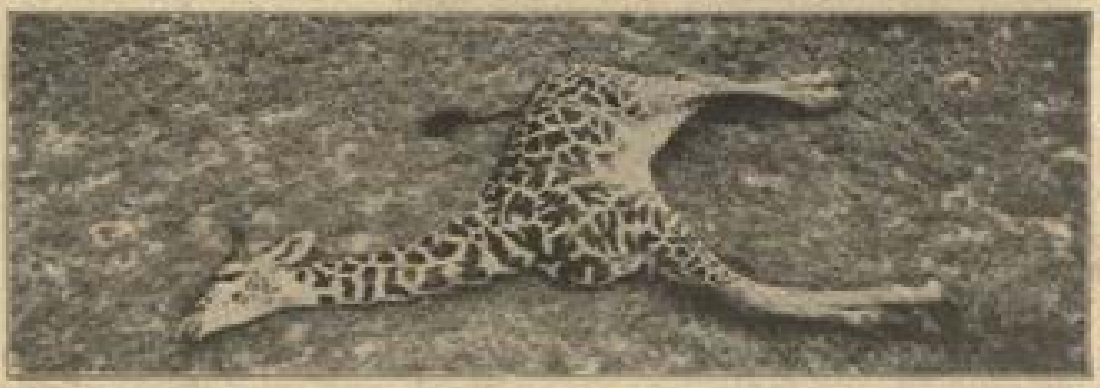
from a specimen collected by A. H. Neumann, the well-known elephant hunter, on the slopes of the Lorogi Mountains in the Northern Guaso Nyiro district of British East Africa. The name Somali giraffe is often applied to this race, but it is quite misleading, as the giraffe is unknown in Somaliland proper, reaching northward no farther than the headwaters of the Webi Shebeyli River in southeastern Abyssinia, where it has been met with by Donaldson Smith, Major Wood, and a few other sportsmen.

We found this very handsome giraffe only along the Northern Guaso Nyiro. In habits we saw no difference between it and the common giraffe; its range touched on the northern range of two of the varieties of the latter, but there was no apparent intergrading between them here, whereas the two species of oryx of the same region, the *beisa* of the Northern Guaso Nyiro, and the *callotis* of south of the Athi, did show a tendency to intergrade.

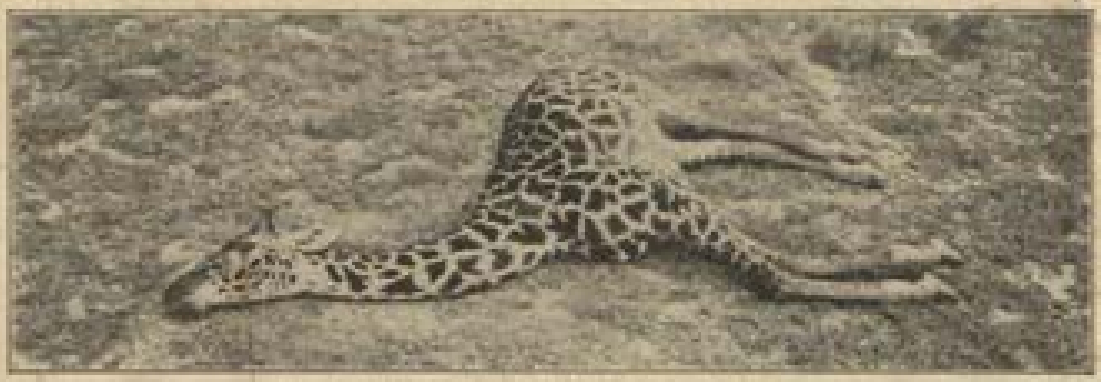
All giraffe are conspicuous animals which make no effort to hide or escape observation, and which are always on the lookout for their foes. At a distance such that the spots on the coat cannot be seen, the general tint of the common giraffe's coloration becomes neutral, so that in many lights it does not stand out from the landscape, and then it is only its size and shape that render it conspicuous. But the handsome chestnut red of the reticulated giraffe makes it conspicuous by its color, not merely near by, but at a distance. We do not believe, however, that this difference in the revealing or advertising quality of the coloration of the two giraffes makes any difference one way or the other in the life-history of either. Probably no other animal is less capable of being helped or hurt by advertising or concealing coloration than the giraffe. Although exclu-

sively a browser, eating only twig tops and blossoms, it lives in dry, open country, in which the trees do not, as a rule, grow close together; it rarely or never ventures into dense forests of the kind in which elephant and other moisture-loving big game often dwell. Its only beast enemy, when adult, is the lion; even the lion attacks it infrequently, and the lion usually hunts its prey by scent; moreover, if a giraffe were near enough for the coloration pattern of its coat to be distinguishable, the lion would be certain to see it anyhow, unless conditions were such as to make all animals escape observation. In any varied landscape, where the ground is accidented, where there are trees, and lights, and shadows, a motionless object of any shape or color may, under certain conditions, escape observation; and any game may, under such conditions, escape the eye even of a wild beast or a native hunter; but even under these conditions the giraffe is far less likely to escape observation than is any of the antelopes, or the buffaloes, or even the rhinoceroses. If it is in such a position that it can be seen at all, it can be seen far more readily than any other animal, except, perhaps, the elephant. Its coloration is of no consequence whatever in enabling it to escape from its foes. When feeding, when coming to drink, when resting, it never seeks to evade observation, and trusts entirely to its own wariness, to its keen senses, especially to its sight, and its speed, for protection.

When we say that the giraffe does not go into dense forests we are using the words one would use in describing tropical forests of the low, wet country. The giraffe is often found in dry thorn forests, but they are sufficiently open to enable a horseman to follow his game at speed. Along the



MASAI GIRAFFE, CALF
Shot by Theodore Roosevelt, Loita Plains



MASAI GIRAFFE, IMMATURE FEMALE
Shot by Theodore Roosevelt, Loita Plains

MASAI GIRAFFE, ADULT MALE
Shot by Theodore Roosevelt, Kilima Kai

UGANDA GIRAFFE, MALE
Shot by Kermit Roosevelt, Uasin Gishu Plateau

THE MASAI AND UGANDA RACES OF THE GIRAFFE

Northern Guaso Nyiro we found the reticulated giraffe sometimes in bare plains with a few trees scattered over them, sometimes in thick, dry thorn-scrub, composed either of low acacia-trees or of tall camel-thorn or wait-a-bit bushes. The giraffe's hide is marvellously thick. The animals would gallop right through patches of thorn scrub around which we had to steer our horses under penalty of having our clothes—and skins—torn to ribbons.

Along the Northern Guaso Nyiro most of the big animals were drinking regularly, either in the river itself or in the rare tributaries. The country was dry as a bone, the leaves on the thorn-trees and the harsh grass having withered under the intense heat of many rainless months. At the good drinking-places the ground was cut deep by innumerable footprints of buffalo, eland, oryx, big zebra, common zebra, waterbuck, impalla, and gazelle. At one time or another we saw most of these animals drinking; we are convinced that they were all drinking regularly, probably once a day. We never saw the gerenuks drinking or saw their tracks at the watering-places, and we met individuals in places so far from water that we are confident they were not drinking at all. We never saw the footprints of the giraffe at any of the watering-places save one, where we also once saw two of the animals themselves; and in one place we kept in touch for three days with a herd which we are reasonably confident did not drink during that time. Be this as it may, it is absolutely certain that in portions of Africa giraffes and certain antelopes—oryx, eland, hartebeest, and others—pass long periods of time, probably months, without drinking; and where other antelopes, such as gerenuk, never drink at all; and this when the heat and dryness are such that it

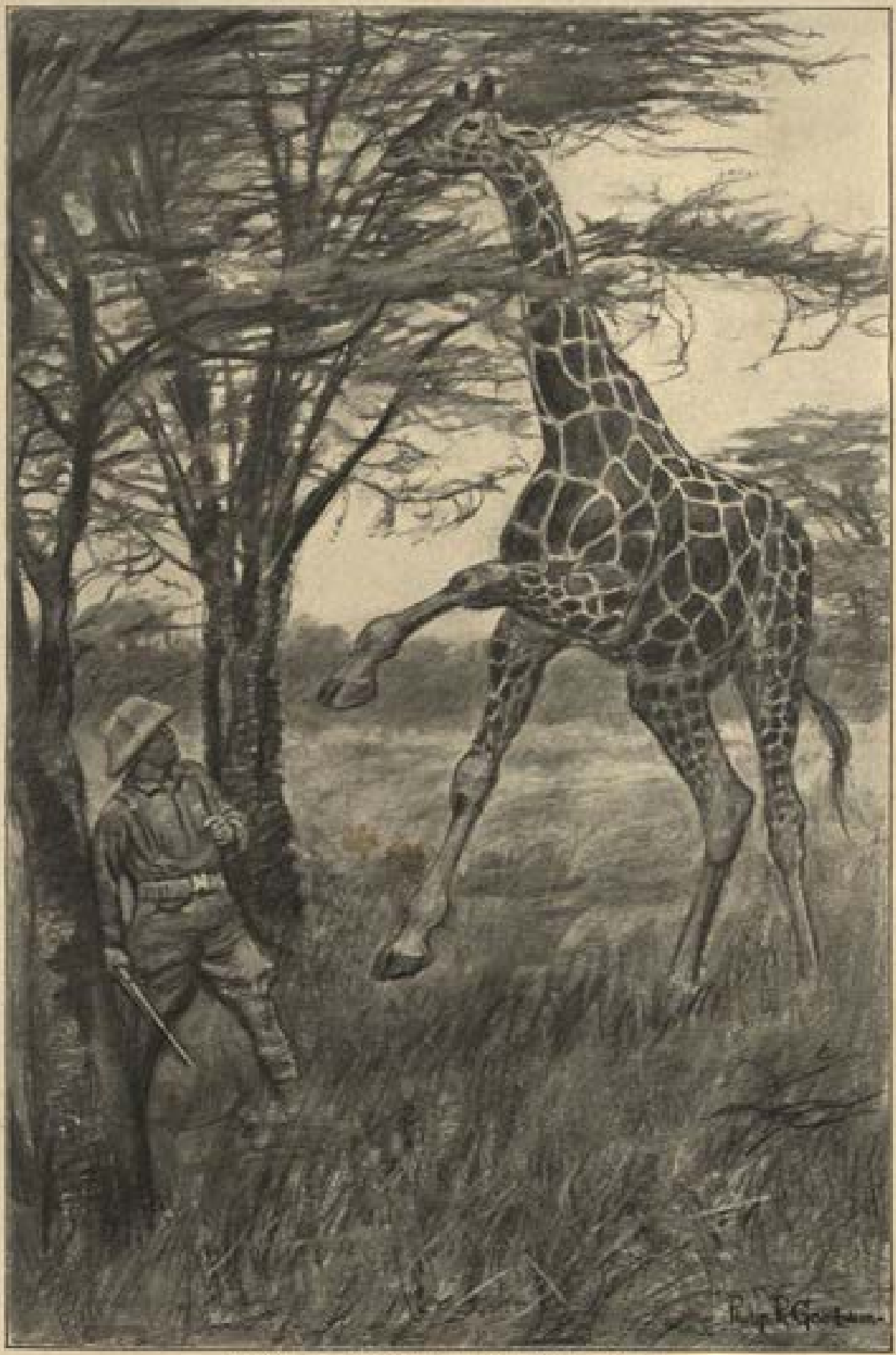
would seem as if every particle of moisture in the big bodies would be sucked out. A white man or an average native will die of thirst within forty-eight hours in the same regions where these big beasts thrive without any water. Doubtless there are some bulbs, some plants, from which they get a little moisture. But the matter is so puzzling that it would be well worth while for a first-class field naturalist, of the stamp of Carl Akeley for instance, to study it carefully in the field. Such studies of the life-histories of the big game would be more valuable than any series of specimens of all but the very rarest species.

We needed for the museum two specimens of the reticulated giraffe, a bull and a cow. A cow was killed after a good gallop, and a bull by fair stalking. The latter was the only giraffe we ever thus killed, as, with the exception of the ostrich, they are the wariest African game and the hardest to stalk; and when we examined the dead body we found that the explanation was not the skill of the stalker but the fact that the bull, a very old one, was evidently beginning to lose his eyesight. After these two specimens were secured, we did not have to molest giraffes again, and devoted what time we could to studying their habits.

Any man who is much in the wilderness will have occasional queer experiences with animals, which are of interest but mean nothing; and other experiences which mean a great deal but the meaning of which it is difficult to unravel. It is hard either to observe or to understand the psychical and mental workings of animals and the strange individual and communal actions which sometimes interrupt the monotonously simple routine of their ordinary lives. As an instance of the first kind of experience, while hunting along the North-

ern Guaso Nyiro, we twice came on giraffes asleep. Both were cows. One was standing erect among clumps of wait-a-bit thorn, its eyes closed and head nodding, precisely like a horse which is sleeping on its feet. Our party, walking in plain sight, got within thirty yards before it waked; and it was so startled that it fairly gave a grotesque plunge as it got under way. The other was also a solitary cow, which we had stalked thinking it might be a bull. It was strolling about, and at times thrust its head among the branches of some tall acacia and stood motionless. When it finally seemed to come to a permanent halt, Cuninghame said it was asleep, and Colonel Roosevelt started toward it to see how close he could get. Cuninghame and the gun-bearers stayed a hundred yards behind. It was open ground, and Colonel Roosevelt walked straight toward it. When about forty yards off it looked drowsily at him. He stopped still, and in a few moments it again closed its eyes and he walked forward to within a dozen feet of it. It then waked up but was not in the least frightened; it pouted its lips peevishly at him, and, rearing, hit at him with one foreleg, but struck short. The other men ran up, and all stood talking and laughing a few paces from it while it looked sulkily at them. The men kept under the branches of the tree so that it could not charge them, as they did not wish to be forced to hurt it. Finally they pelted it with sticks and clods of earth, and it slowly withdrew, quite unconcerned. All the giraffes in this district were relatively tame, but no others let us get within two hundred yards, and if they saw us they usually ran long before we got within that distance. We do not understand the sulky indifference to our presence shown by this cow.

The other instance may—we only say "may"—have signified something more noteworthy, something in the way of an understanding about a meeting-place, or at least the desire for companionship. Generally we saw giraffes in herds or small parties. If thirty or forty were together, there were usually several old bulls; but a little band of half a dozen or so might contain a bull or might consist only of cows and calves—and, by the way, the young giraffes always struck us as being more alert, lively, and suspicious than the old ones. We also came on giraffes singly or in couples; and these solitary ones might be either bulls or cows. At one of the drinking-places frequented by the game along the Northern Guaso Nyiro, and at only one, we saw the huge footprints of the giraffes mingled with the hoof-marks of bucks and zebras. Late one afternoon, while returning to camp with the gun-bearers, one of us (Colonel Roosevelt) thought he would glance at this water-hole. Before reaching it he found the track of a single giraffe leading to it. When a quarter of a mile away he saw the giraffe standing in the open, perhaps a hundred yards from the water. The giraffe stood motionless, looking toward some low hills—not back along his own track, but in a nearly opposite direction. Colonel Roosevelt had no thought of harming him, and wished to see him drink—giraffes straddle their forelegs wide apart, either laterally or fore and aft, in order to drink. The giraffe stood in the same place and position for fifteen or twenty minutes. Then suddenly another giraffe appeared round a low hillock, a long distance off, coming toward the water. It stopped short, apparently on seeing the first one, when not very far away. After gazing for some time the newcomer resumed its march. It halted on coming beside the other, and the



DEFENSIVE ACTION OF RETICULATED GIRAFFE
From a drawing by Philip R. Goodwin

two continued to stand near one another, or walk a few steps in one direction or another. They did not drink or do anything; and finally, as there was a long distance to go before reaching camp, Colonel Roosevelt reluctantly left them. It seemed, judging from the first giraffe's long stand in an attitude of expectancy, as if it had come to this spot as a trysting-place, or at least with the expectation of meeting one of its fellows—whether lover or friend we cannot say. Of course, the explanation may have been merely that it had become aware of the oncoming stranger while the latter was still a long distance off; but we doubt this, for we were keeping a sharp lookout, and we believe that the second giraffe was far away, beyond ken of sense, when we began to watch.

Most of the big plant-eaters of the plains, as distinguished from the flesh-eaters and also from the plant-eaters of the forest, seem to crave companionship. Two animals may form an attachment for one another just as human beings do. When in the Western ranch country, in the old days, we always found the saddle band split into little groups, many of the horses having each his companion or companions, from which he would not willingly separate. Probably the same thing is true in the herds of wild game. It is certainly true of the individuals which are found in couples. Often a solitary individual of one species will strike up a friendship with an individual of an utterly different species; or an outcast, or perhaps merely an individual of freakish tastes, will be accepted into a herd of a different species. At one permanent camp we found a wildebeest bull steadily associating with a herd of the small Tommy gazelle; and a doe of a Tommy was associat-

ing with, and was accepted as leader by, four of the big Grant gazelles. We saw a zebra and an oryx which had evidently become partners, and a hartebeest and a topi which had done the same. We heard of a case in which an old bull hartebeest had thus attached himself to a rhino. Mr. Schillings, a capital observer and writer, was the first naturalist to insist on this craving for companionship, this genuine spiritual need of fellowship among these big animals. In his "Flashlight and Rifle" he mentions the case of a bull giraffe which entered into close alliance with two bull elephants; and he was able to bring out from Africa a young rhino, alive, largely by providing it with companions in the shape of two goats. Doubtless the element of added safety against foes is largely, probably chiefly, responsible for such companionship; but we think it also meets a real psychical need of at least certain animals.

The reticulated giraffe is marked on the neck by distinct reticulations, formed by the large rufous squares being set off sharply by narrow lines of white ground-color. This color pattern is so distinctive from the usual blotched coloration of other giraffes that the race has been considered a distinct species by many naturalists. Some specimens of the Uganda giraffe, however, show as narrow reticulations, but the ground-color is seldom so whitish in appearance. The horns of the bull are well developed, the frontal horn being especially large and is exceeded in height only by the Uganda race. The body is marked by large squares of rufous separated by ochraceous reticulations, and differs decidedly from the small size and broken-edged spots of the Masai giraffe. The legs from the knees and hocks downward nearly as far as the fetlocks are reticulated by buffy-whitish ground-color and tawny blotches. One of the distinctive color marks of this race is the carrying forward of the reticulated pattern of the neck over the cheeks and the upper throat to the chin. The mandible shows distinctive

characters, being low at the condyles and having short coronoid processes. The frontal horn is remarkably robust and of great circumference, and is scarcely less in height than in the Uganda race; but the skull itself at this point is much less in height.

In body size the reticulated giraffe is less than the Uganda or Masai races. The height of the bull seldom or never exceeds sixteen feet. The skulls are also proportionately smaller and range from 23 to 24 inches in length. An adult pair shot by Colonel Roosevelt on the Northern Guaso Nyiro had the following flesh measurements: head and body: male, 12 feet 6 inches, female, 11 feet 11 inches; tail, 2 feet 11 inches; hind foot from hock to hoof, 3 feet 4 inches; ear, 8½ inches; height to crown of frontal horn, male, 15 feet 4 inches, female, 14 feet 8 inches. The color of the two specimens is very similar, the male being but little darker than the female. In body size they are very similar, the male being greater only in body length and height and more massive skull, but the length of the latter is slightly exceeded by the female skull. The material examined has consisted of the original type and some other specimens from British East Africa at the British Museum, a mounted specimen at the Carnegie Museum collected by Childs Frick on the Northern Guaso Nyiro, and five specimens at the National Museum from the latter locality. All of these specimens agree in the rich rufous blotches and narrow white reticulated ground-color of the neck and are in no way intermediate with the Masai giraffe, which occupies the region just south of Mount Kenia, from the south bank of the Tana River southward. The variable Uganda race, however, approaches the reticulated more closely in color, some specimens from the Uasin Gishu being scarcely distinguishable. Specimens from the region immediately south of Lake Rudolf will, no doubt, be found to be fully intermediate in character. Some of the skulls from the Northern Guaso Nyiro show well-developed posterior or fifth horns, a character at one time supposed to be a peculiarity of the Uganda race. In one of these skulls the development of the fifth horn is greater than in any specimens of the latter race.

The reticulated giraffe has been recorded by A. H. Neumann as far northward as the mouth of the Omo River

at its entrance into Lake Rudolf, and by Donaldson Smith from Lake Stephanie and the country east as far as the Webi Shebeyli River. The southeastern and southern limits of the race in the Tana district are not yet known. Lydekker has given the racial name *nigricans* to a small piece of body skin from the Kenia district bearing black blotches separated by narrow, white reticulations, which apparently came from an individual of this race. It is unfortunate that so well known a naturalist as Lydekker should add to the burden of zoological nomenclature by attaching a scientific name to a mere fragment of skin of so variable a mammal as a giraffe.

Uganda Giraffe

Giraffa camelopardalis rothschildi

Native Names: Luganda, *eniuga;* Suk, *agouri;* Bari, *kurri;* Sudani, *zaraff;* Dinka, *mehr.*

Giraffa camelopardalis rothschildi Lydekker, 1903, in Hutchinson's Animal Life, II, p. 122.

Range.—From the Uasin Gishu Plateau and Lake Baringo northwestward over the highland and desert region of Uganda to the latitude of Gondokoro; east probably as far as the west shores of Lake Rudolf and west as far at least as the east bank of the Nile; limits of range not known.

The Uganda race has frequently been designated the five-horned giraffe, owing to the occasional development of two small horns at the extreme hinder part of the head behind and above the ears. These so-called fifth horns are never more than mere rounded knobs an inch in height, and are only to be found in some aged bulls. The presence of a fifth pair of horns is not a peculiarity of the Uganda giraffe, but is shared by the reticulated as well and appears to be carried to a somewhat greater development in the latter race. Bony excrescences of equal prominence to the fifth horns also occur not infrequently above the orbits and sometimes as adventitious knobs on the sides of the main horns. In old age the skulls of the bulls produce a great amount of dense bony tissue which greatly adds to

the size of the horns and cements the whole upper surface of the skull together, obliterating all the sutures and producing odd knobs of bone in various places as well as over the orbits and at the back of the skull.

The type specimen of the Uganda race is the adult bull shot by Major Powell-Cotton on the Uasin Gishu Plateau and is now a mounted specimen in the British Museum. The race has been named by Lydekker for the donor of the specimen to the museum, the Hon. Walter Rothschild, of Tring. Sir Harry Johnston was the first sportsman to collect specimens of this race and call the attention of British naturalists to its apparent distinctive horn characters. Some years later Major Powell-Cotton collected complete specimens at the expenditure of great personal labor and considerable cost in the Uasin Gishu Plateau, at Lake Baringo, and in the Toposo country north of Mount Elgon and east of the Nile station of Nimule. The specimen from the latter locality was considered by Lydekker as a different race, which he named *cottoni*. Its color differences, however, are well within the range of Uasin Gishu specimens, with which it is racially identical. The differences detected by Lydekker were the absence of black in the neck blotches, their larger size and more regular outline, which are the very characteristics shown by the bull shot by Kermit Roosevelt on the Uasin Gishu Plateau. Specimens like these, which exhibit a narrow pattern of reticulation on the neck, are quite intermediate between the blotched coloration of the type specimen and the reticulated race.

The Uganda giraffe is distinguishable from the other equatorial races by its much more massive skull, the frontal horn being especially high, and the main horns being as a rule decidedly thick and massive. The body size is correspondingly somewhat greater and exceeds that of any other race except the South African, which it equals. Adult bulls have a height of 17 or 18 feet. The body is marked by large, regular spots separated by narrow reticulations as in the reticulated, but the neck may be either reticulated or blotched similarly to the Masai giraffe. The legs below the hocks and knees are uniform cream-buff, without darker markings, and are quite similar in this regard to the typical Nubian race. The bulls are not con-

sistently darker than the cows, but vary from seal-brown to tawny in coloration, independent of age.

The adult bull shot by Kermit Roosevelt had a height of 17 feet 3 inches to the top of the horns. The other flesh measurements of this specimen were: length of head and body, 12 feet 10 inches; tail, 2 feet 10 inches; hind foot from the hock to the hoof, 4 feet 1 inch; ear, 8½ inches. Skull length, 25¼ inches. A skull from Lake Baringo in the National Museum has a length of 26 inches and is the maximum in size examined. Two female skulls from the Uasin Gishu at the British Museum measure 23 and 23¾ inches, respectively. Powell-Cotton records a height of 17 feet 3 inches for his largest bull from the Uasin Gishu.

The Uasin Gishu Plateau represents the most southern as well as the highest altitude attained by this giraffe. It is essentially a Nile race which has made its way eastward to the headwaters of the 'Nzoia River on the Uasin Gishu Plateau, and then spread over the watershed and down into the Rift Valley at Lake Baringo, east of which it meets the reticulated race. The race occurring on the west bank of the Nile may be *congoensis*, the typical specimen of which came from the head of the Welle River within close proximity of the Nile watershed of the Bahr el Ghazal. Giraffes were seen near Rejaf by Colonel Roosevelt, at Lado Station by Major Powell-Cotton, and they have also been reported in the vicinity of Mahaji west of the Albert Nyanza by sportsmen. What race occurs in the Lado Enclave district is at present unknown, and it is desirable that sportsmen preserve complete specimens from the Lado or upper Bahr-el-Ghazal districts for identification.

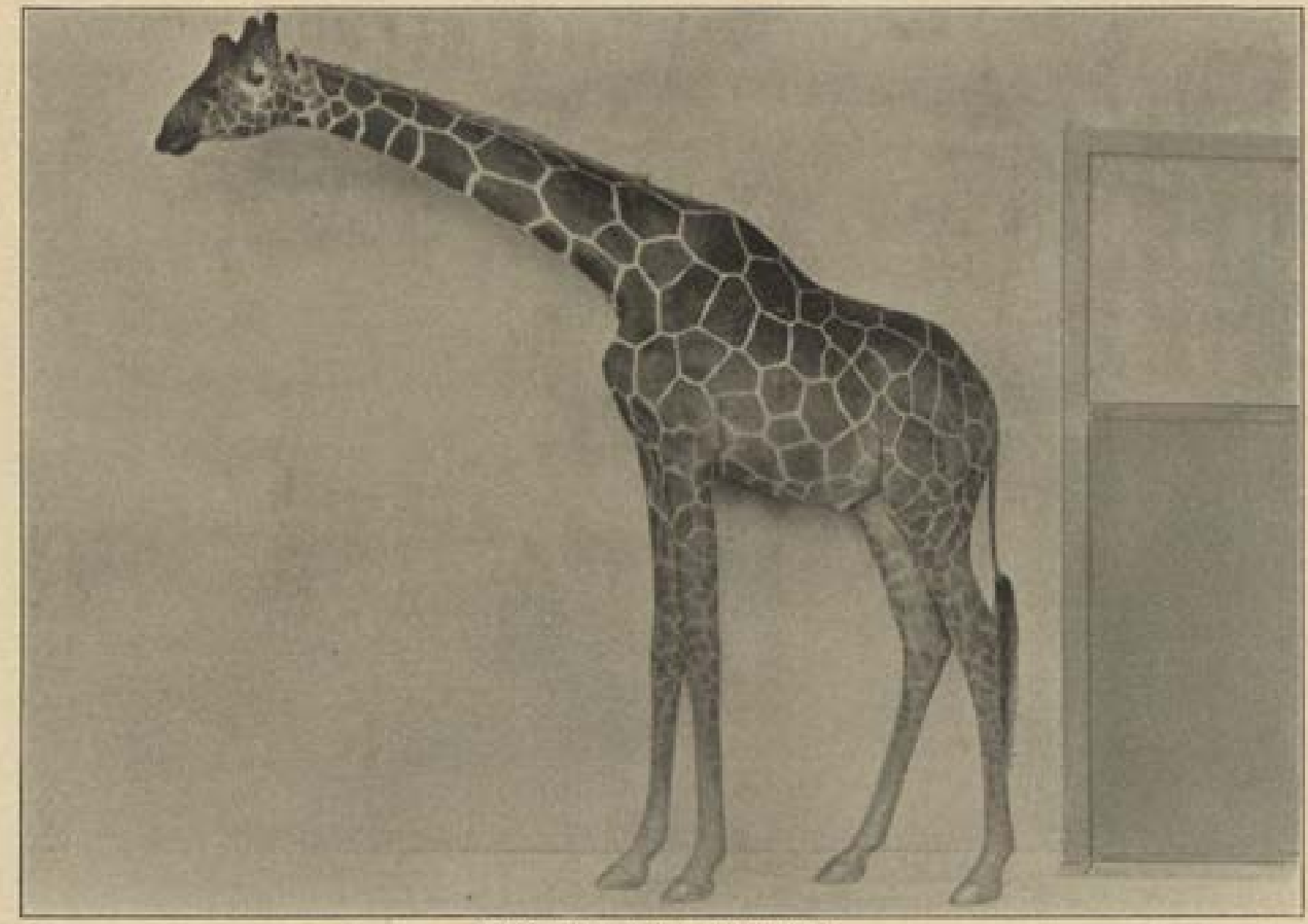
Masai Giraffe

Giraffa camelopardalis tippelskirchi

Native Names: Swahili, *twiga;* Kikamba, *ndwi;* Kikuyu, *ndoiga;* Masai, *oloadokiragata.*

Giraffa tippelskirchi Matschie, 1898, Sitz.-Ber. Ges.Nat. Freunde, Berl., p. 77.

Range.—British East Africa from the south bank of the Tana River, the southern slopes of Mount Kenia, Lake Nakuru, the Loita Plains, and Amala River drainage



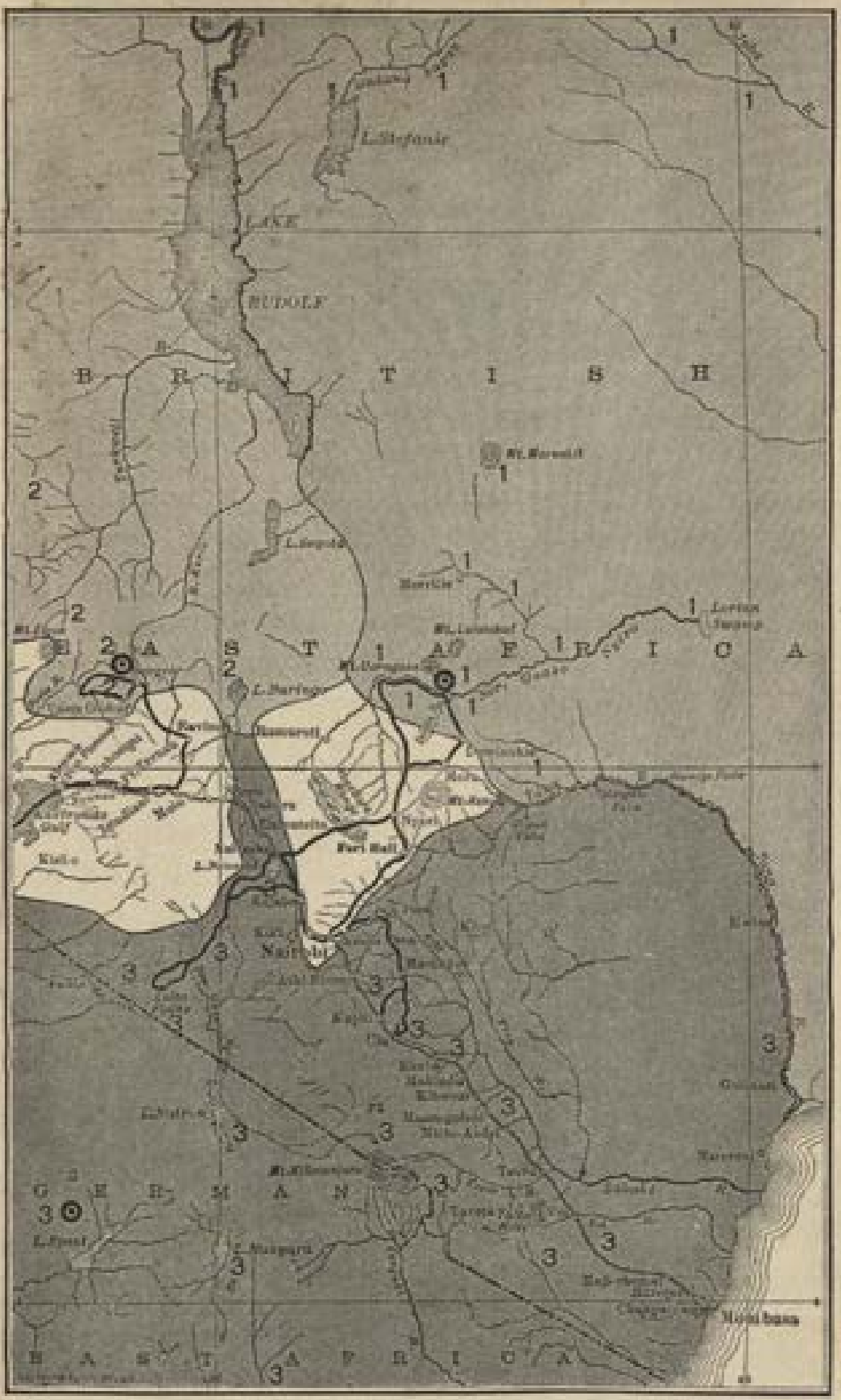
RETICULATED GIRAFFE, ADULT MALE
Shot by Theodore Roosevelt, Northern Guaso Nyiro River
Mounted by G. B. Turner, in the United States National Museum

southward to central German East Africa at least; limits of range unknown.

A specimen of giraffe from Lake Eyasi in the Rift Valley of German East Africa collected by Herr von Tippelskirch was made the type of the Masai race by Matschie in 1898. Previous to this sportsmen had been accustomed to separating the giraffe into two races, a northern form having a high frontal horn and unspotted legs and a southern, which lacked the frontal horn and had blotched or spotted legs. The equator roughly marked the dividing line of these two forms, the reticulated and the Uganda giraffe being classified as members of the typical or northern race, *camelopardalis*, and the Masai with the Cape race, *capensis*. The Masai giraffe, however, differs widely from the South African by the well-developed nature of the frontal horn and the peculiar stellate or dissected margins of the dorsal blotches. By this latter characteristic it can at once be distinguished from the other equatorial races. The body spots differ not only by their jagged outline but also by their much smaller size, there being fully twice as many in an area of equal size. The stellate character of the spots appears to be quite the same from youth to old age. The blotches of the neck, however, are regular in outline and are quite indistinguishable from those of the Uganda race. A specimen from Taveta, Kilimanjaro, in which the legs are unspotted has been described as *schillingsi* by Matschie, but it has been shown by Lydekker that spotted-legged specimens also occur at Kilimanjaro and that the coloration of the legs is subject to much individual variation. There are in the National Museum six specimens of this race from British East Africa, five of which have spotted legs and one, an adult female, unspotted, uniformly light buff-colored legs, quite like those of the Uganda race. This individual was shot on the Loita Plains from a herd of six, together with two others, an immature female and a calf, both of which have spotted legs. The calf was the offspring of the adult cow, and the immature specimen doubtless bore the same relation, for they were closely associated together in a small herd. The range of coloration in the dorsal blotches of these three is really great. The immature cow is quite the darkest giraffe examined of any race and is a uniform seal-brown relieved by narrow broken re-

ticulations of buff. The adult female is marked by bistre-brown spots, while the calf is a light cinnamon-brown color. Three adult bulls shot by Colonel and Kermit Roosevelt near Ulu Station on the eastern edge of the Kapiti Plains are remarkably uniform in color and have spotted legs which are tawny in ground-color. The coloration of the series of six specimens in the National Museum illustrates well the great individual range and the danger of confusion which may result from the description of races on single specimens.

The common giraffe, or that variety of it occurring over the southern portion of British East Africa, and the variety known as the five-horned giraffe, are identical in their habits with the reticulated giraffe. They live in the same kinds of country, varying from desert to fairly well-watered plains covered with a rather thin growth of acacia forest. They browse; they drink when water is plentiful; and they go without water for weeks if necessary. They are found in small parties, or herds of twenty or thirty individuals, or singly. They are usually the most wary of game; and yet at times show foolish tameness. On one occasion, out of a small herd of seven, two cows and a young one—the only wary or sensible animal among them—were shot for the museum; and the bull, the remaining calf, and the two remaining cows hung round the neighborhood for some hours, so little frightened that they permitted Kermit to get good photos of them. In the land through which we travelled we found that the giraffes slept standing; but, as is the case with elephants, some individuals, and in some localities all the individuals, habitually lie down to sleep. We did not find the old bulls darker than the cows; sometimes an old bull was the lightest-colored animal in a herd, and a small cow might be the darkest.



MAP 4—DISTRIBUTION OF THE RACES OF THE GIRAFFE

1 *Giraffa camelopardalis reticulata* 2 *Giraffa camelopardalis rothschildi*
3 *Giraffa camelopardalis tippelskirchi*

Giraffes are such strange, picturesque creatures, and so harmless that they ought to be killed only when absolutely needed for scientific purposes. To ride them down in a headlong run is good sport, of course. Their leisurely, awkward-looking gallop carries them along at a fast gait; the tail twisting, the neck thrust forward at an angle, the hind legs coming up outside the fore ones with piston-like regularity. Buffalo Jones, with his cowboys, Means and Loveless, roped a giraffe, as they did a rhino and a lioness. Such feats rank even higher than the feats of the Masai and Nandi in killing lions with their spears on foot, and the feats of the Hamran horsemen in killing all big game with the sword; and from the standpoint of bodily prowess, all of these feats stand far ahead of the feats of the rifleman.

The flesh measurements of the largest bull from Ulu were: head and body, 13 feet 4 inches; tail, 3 feet 2 inches; hind foot, 4 feet 5 inches; ear, 9¼ inches; height, 17 feet 2 inches. The second largest bull had a height of 16 feet 3 inches. The skulls of these two specimens are quite the same in size and have a length of 25½ inches. The adult female from the Loita Plains measured in the flesh: 14 feet 7 inches in height; 11 feet 8 inches in length of head and body; tail, 3 feet; hind foot, 3 feet 9 inches; and ear, 9 inches in length. Besides the six specimens at the National Museum others have been examined from the Athi Plains and Maungu Station at the American Museum of Natural History of New York, and a mounted specimen from Kilimanjaro at the British Museum. In the field herds have been seen near the railway stations of Voi, Simba, Makindu, Kui, and Ulu, in the Rift Valley, near Mount Suswa, and on the Loita Plains. They occur practically everywhere throughout the desert nyika of the coast and inland through the bush country to the edge of the grassy plains up to an altitude of 7,000 feet.

CHAPTER XII

ROAN, SABLE, AND ORYX

Introduction to Family *Bovidæ*

The *Bovidæ* comprise the oxen, sheep, goats, antelopes, and their allies. There is, unfortunately, no general term in English for the group. The popular term of antelope, which comprises nearly all of the species here considered, has, furthermore, no zoological significance, but is merely a term under which have been banded together the genera not closely related to those which have given rise to the domesticated races of oxen, sheep, and goats. The various so-called "antelopes" differ from one another more widely than some of them do from oxen and than others do from goats. The roan, the hartebeest, and the eland, for example, all differ from one another and from the water-bucks or gazelles as much as from the buffaloes. Some antelopes are more divergent from the more generalized forms than are the oxen. The family may be defined as two-toed, ruminant, hoofed mammals bearing, in the male sex at least, frontal appendages in the form of horns supported by bony cores arising from the frontal bones, and having the false hoofs rudimentary or without any bony attachment or else absent. They differ from the deer or *Cervidæ* chiefly by the character of the horns, which are hollow and chitinous in structure and of dermal derivation, the bony core alone being homologous to the horns of deer.

They range over the whole of Africa and Asia, including Japan and the larger Malay Islands to southern Europe, and over North America from northern Mexico to Greenland. Geologically, the family ranged from the Lower Miocene to the present time. The most ancient types are represented to-day by the antelopes of Africa, the bulk of which have been found as far back as the Miocene in Eurasia. No remote ancestral types are known. The oldest forms geologically, the *Tragocerinæ*, had flattened horns resembling those of the goat. Other Miocene species of almost equal antiquity were the Egocerine forms allied to the sable and the oryx, as well as several extinct genera of the Tragelaphine or bushbuck type. In expressing the relationships of the subfamilies of African antelope by diagram, we have assumed that the sable and its allies represent the most ancient group, owing chiefly to their more primitive skull characters. As no mere linear arrangement of groups is satisfactory, the diagram has been resorted to to express our ideas of the relationships more clearly, and we wish to emphasize the fact that the linear arrangement we have actually adopted is unsatisfactory and is merely adopted because there had to be some kind of linear arrangement, and this was, perhaps, a trifle less unsatisfactory than any other. The arrangement in the diagram is based on a study of the affinities of the recent species as shown by their skull structure and horn characters. The *Bubalinæ* are an aberrant group which do not fit in well with the characters shown by the others and may represent some of the most ancient types. The *Bovinæ*, or oxen and buffaloes, although one of the youngest or most modern groups, has characters which ally it most closely to the very oldest genera. The

EAST AFRICAN ROAN ANTELOPE
In the New York Zoological Park

NILE ROAN ANTELOPE, ADULT FEMALE
Gondokoro, Uganda

EAST AFRICAN ROAN ANTELOPE
ADULT MALE
Shot by Paul J. Rainey, Amala River

THE RACES OF ROAN ANTELOPE

most highly specialized seem to be the gazelles, although they really extend far back geologically to the Miocene age.

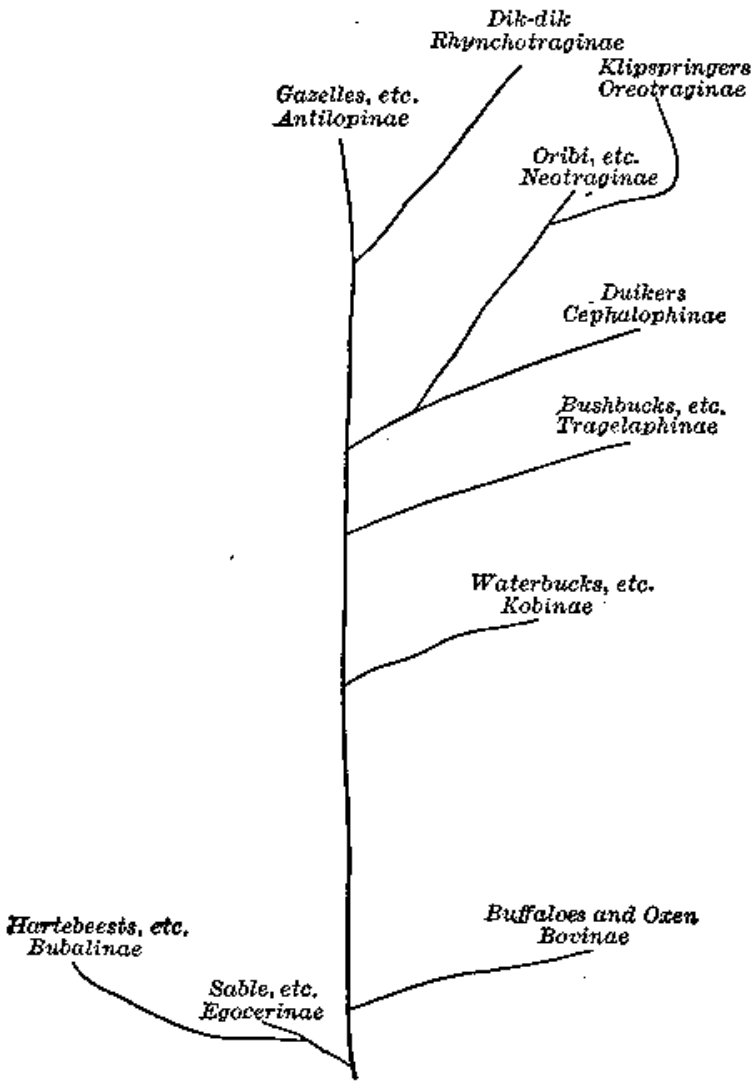


Diagram of the family Bovidæ showing relationships of the subfamilies

There are no really remote ancestral types known, the oldest fossil species being quite as distinctly antelope as the living species; so that as yet the paleontological records afford us little clew to the evolution of the group.

KEY TO SUBFAMILIES OF *Bovidæ*

Skull without anteorbital fossa
No anteorbital gland in front of eye
No lachrymal-nasal sinus in skull
Withers much higher than hips; horns rounded at the base, projecting straight backward, curved backward or spirally twisted, ringed at least at the base *Egocerinæ*

Withers not exceeding the hips in height; horns flattened or depressed at base, without rings *Bovinæ*

A well-developed lachrymal-nasal sinus; horns in male only, recurved at tips, ringed *Kobinæ*

A small anteorbital gland in front of eye
Withers higher than hips; horns diverse in shape, but never spirally twisted; skull without lachrymal-nasal sinus; mammæ, two *Bubalinæ*

Withers not exceeding the hips in height; horns spirally twisted; skull with a lachrymal-nasal sinus; mammæ, four *Tragelaphinæ*

Skull with a large anteorbital fossa in the lachrymal bone
Anteorbital gland opening on face by a line of pores; nasal bones usually long, greatly exceeding narial chamber in length; horns short, projecting backward in line with the snout *Cephalophinæ*

Anteorbital gland opening on face as a rounded pore
Nasal bones long, exceeding the narial chamber in length; anteorbital fossa a large pit usually occupying the whole extent of the lachrymal bone
Hair bovine in texture; snout normal, the length exceeding the diameter of the orbit; foot resting on whole under surface of hoof *Neotraginæ*

Hair peculiar in texture, pithy, and brittle; snout short, the length less than the diameter of the orbit; foot resting on tip of hoof only *Oreotraginæ*

Nasal bones short, equalling or less than narial chamber in length

Snout not elongated; tail well developed; horns long, usually exceeding length of head; body size medium; nasal bones longer, seldom less in length than narial chamber *Antilopinæ*

Snout elongated into a proboscis; tail rudimentary; horns short, projecting straight back; body size small; nasal bones very short, less than one-third length of narial chamber *Rhynchotraginæ*

Subfamily *Egocerinæ*

SABLE, ROAN, AND ORYX ANTELOPES

Both sexes of the members of this subfamily bear horns, those carried by the female sex being somewhat more slender but often no less in length than those of the male. The horns are either curved evenly backward, as in the sable, straight, as in the oryx, or spirally twisted, as in the addax. The antelopes of this group are best characterized by their large size, high withers, long ears, and absence of lachrymal glands on the face. Other characters are the long, tufted tail, maned neck, and striped face. The skull lacks an anteorbital fossa, or depression, owing to the absence of the lachrymal gland, but in most of the genera a small lachrymal-nasal sinus is present. The teeth are very long and broad, with well-marked accessory columns in some of the genera, being similar to oxen in this respect. The skull, however, has the long nasals and the slender snout similar to the hartebeest.

The young are very differently colored from the adults, being uniform fawn without any conspicuous markings.

Key to the Genera

Horns curved backward in a great semicircle, at their base arising abruptly above the orbits *Egoceros*

Horns straight or but slightly curved, projecting backward in line with the face and arising behind the orbits *Oryx*

Sable and Roan Antelopes
Egoceros

Egoceros Desmarest, 1822, Mammalogie, II, p. 425; type *Antilope leucophæa* Pallas, the bluebuck.

The well-known name of *Hippotragus*, which has served so long for this genus, has been recently replaced by the older name of *Egoceros*, owing to its possessing a single-letter difference over the older genus *Ægoceros*, which was applicable only to the domestic goats and sheep. Changes of this sort which affect well-known names, and which have been brought about owing to a change in the rules governing nomenclature, tend, unfortunately, to destroy rather than establish stability in nomenclature and are reluctantly accepted by the authors.

This genus is characterized by the long, evenly curved horns which arise vertically above the orbits and sweep backward in a wide semicircle and are heavily ringed for nearly their whole length. The horns are heavier and longer in the male. The face is somewhat striped, but the body is uniform in color on the dorsal surface and the anteorbital glands are absent. The body form resembles that of the hartebeests, the withers being high, and the tail tufted and of medium length. The ears are long and narrow; the snout is somewhat elongate, and the false hoofs are large. Three recent species comprise the genus: the sable, the roan, and the extinct bluebuck. The last-named species was limited to the extreme southeast corner of the Cape Colony, and it was no doubt owing to its limited range that it so early became extinct. The last living specimens disappeared somewhat more than a century ago, so that their extermination can in no way be traced to modern firearms. The sable and roan range from the southern point of Africa northward to the Zambesi River and thence on the East Coast to British East Africa. The latter species continues alone through the central lake region to Abyssinia and the Nile, where it spreads westward to Senegal along the southern edge of the Sahara. The genus is lacking only in the Congo forest region. Five fossil species have been recorded, the oldest from the Miocene of Europe and four later Pliocene species, one from India, another from

Europe, and two from Algeria. Horn cores have been discovered in the Pliocene formation of Nebraska which evidently belonged to an antelope allied to this group, but there is no further American evidence. The genus is one of the very oldest and most wide-spread of antelopes, and is no doubt one of the least specialized of the living forms, as evidenced by the absence of lachrymal glands or specialization in the facial bones.

KEY TO THE SPECIES OF *Egoceros*

Horns not greatly exceeding the head in length; ears very long, exceeding 10 inches; body color a brownish roan in both sexes *equinus*

Horns greatly exceeding the head in length; ears shorter, not exceeding 8 inches; male usually dark seal-brown or black, female ranging from tawny to seal-brown *niger*

ROAN ANTELOPE

Egoceros equinus

RANGE.—The whole of Ethiopia from the Sahara Desert south as far as the Orange River, in South Africa; absent only from the Congo forest region.

The roan antelope is distinguishable from the sable by its conspicuous difference in color and by its shorter horns and somewhat larger body size. The color in both sexes is a cinnamon drab or roan varying somewhat in shade in the several geographical races. Four races are recognizable by slight differences in color and size: the typical race of South Africa is the darkest; farther north, in German and British East Africa, we meet with another, *langheldi;* westward the Nile Valley is occupied by *bakeri*, while in the extreme west, in Senegal, occurs the lightest and smallest race, *gambianus*. The skull, compared with that of the sable, has a much smaller nasal-lachrymal sinus, which is sometimes lacking entirely; the nasal bones are convex on the sides, and the occipital region is much longer.

This big antelope, second in size only to the eland, has a very wide and curiously broken distribution, extending from the Blue Nile and Lake Chad to far south of the

Zambesi. Its distribution is extensive in altitude no less than in latitude, and is evidently far less limited either by climate or by vegetation than is the case with most antelopes. We found it at home on the cold, wet mountains on the road to the Uasin Gishu, and in the hot, dry, low-lying plains along the White Nile, the flora of the two regions differing as widely as the weather. Yet it is plentiful in very few places, and these places are generally isolated, and separated from one another by large tracts from which it is totally absent. Sometimes it is the only large antelope found in a region; far more frequently it is found where other species of antelope swarm. Different kinds of hartebeests, for instance, abound in many parts of its range, and usually in a locality where both are found the hartebeests outnumber the roan a hundred to one. Yet the range of the hartebeests is far more limited. It is difficult to conjecture why the roan, which has characteristics that enable it to stand such differences of temperature and of vegetational and geographical conditions, and to range over such a wide extent of territory, should, nevertheless, hardly anywhere be able to multiply so as to hold its own in numbers with other antelopes which are wholly unable to adapt themselves in like fashion to change of environment.

Both on the high, wet, cold mountain slopes and plateaux, and in the low, dry plains, we found the habits of the roan the same. We found them most often in herds; but we came across solitary bulls, and we also found them in couples, usually a bull and a cow, and once we saw three yearlings together. They were commonly found in the open plain, but also in thin acacia bush; and on the Uasin Gishu Mountains we saw them freely enter and leave the

patches of high forests and bamboo, which were traversed in many directions by their beaten trails. We found them lying just within the border of the forest, and we also saw them lying down in the open. We found them feeding at all hours, and on the move at all hours. They seemed ordinarily to rest for two or three hours, and then to graze for a longer period. On the Uasin Gishu Mountains they were the only animals feeding on the rank, coarse, abundant pasturage. In one place they came to water in the daytime, sometimes daily, sometimes every second day; in another place we found where one had drunk in the night-time. They are not very fast, but we found them wary. They are the fiercest and most savage of antelope, with the possible exception of the sable. Hunters have been killed and wounded by them, because of approaching them carelessly when at bay. A wounded bull charged Kermit with the utmost ferocity. The roan is almost the only antelope which, when at bay, will frequently charge when its pursuer is still some distance off. They are not, of course, to be classed with the really dangerous game; but they are more dangerous than a moose or black bear or cougar, for instance.

KEY TO THE RACES OF *equinus*

Front of pasterns tawny-rufous, like rest of leg; ears tawny; horns shorter *langheldi*

Front of pasterns buffy-white, in contrast to the tawny leg; ears light-colored, pinkish-cinnamon; horns longer *bakeri*

EAST AFRICAN ROAN

Egoceros equinus langheldi

NATIVE NAMES: Kinyamwesi, *kolongo;* Kaviroudo, *omuga.*

Hippotragus langheldi Matschie, 1898, Sitz.-Ber. Ges. Nat. Freunde, Berl., p. 182.

RANGE.—German and British East Africa, from Central German East Africa north through British East Africa to Mount Kenia, and westward to Mount Elgon; very local in distribution, the localities being widely isolated.

The East African roan was described by Doctor Matschie in 1898, from specimens collected near Tabora, southeast of the Victoria Nyanza, by Captain Langheld. In the same year, but some months later, Herr Oscar Neumann described the race under the name of *rufopallidus* from specimens which he had collected in Irangi, German East Africa, but the latter name is not accepted by naturalists who follow a strict law of priority in nomenclature. The first men to meet the roan in East Africa were the explorers Speke and Grant, who collected a specimen at Kazeh, a station now known as Tabora.

The East African race is recognizable with difficulty from *bakeri* of the Nile Valley, owing to the great individual variation in color among adults. There is, however, usually a decided difference in the darker color of the front of the pasterns, which are uniform in color with the legs; the ears are also darker, being tawny, but there is no difference in the length of the hair at the tips, which is usually given as the chief difference. The dark patch on the chest is larger and darker, as a rule, and the general body color may be somewhat darker. Two adult specimens, shot from the same herd in the Amala River district by Paul J. Rainey, show well how great the individual variation is. One is dark grayish-drab, the other very light pinkish-cinnamon. The skull exhibits a considerably shorter snout, the portion in front of the premolars usually being less in length than the tooth row, while in *bakeri* it is usually decidedly greater.

The usual coloration of the dorsal parts is vinaceous-buff, becoming somewhat darker on the hinder part of the body, where the black of the tail projects onto the rump as a dark stripe. The whole dorsal surface is dotted sparingly with cinnamon hairs. The hair is rather longer on the lower side of the neck, where it forms a throat mane as in the waterbuck. The snout, upper and lower lips, chin, stripe from the base of the horns past the front of the eye, and a rounded patch behind the eye are white; while rest of face, including the forehead and cheeks, is seal-brown or black.

The white patch in front of the eye ends in a considerable tuft of very conspicuous longer hairs. The very long, pointed ears are cinnamon on the back and around the base, pencilled with black at the tips, and have the inside white. The dorsal mane of stiff, erect hairs, the longest attaining a length of five inches, is cinnamon at the base, tawny above, and terminally black, and extends from behind the ears to the middle of the back. The chest and the inside of the forelegs are seal-brown, and the outside is tawny, marked by a wide stripe of seal-brown. The belly and the inside of the hind legs are white. The tail reaches the hocks and has a tuft of long, black hairs at its extremity. Newly born young are uniform cinnamon without the black leg stripes, but with a narrow band of black bordering the false hoofs. They have the tip of the tail blackish; and the top of snout walnut-brown. Stripe before eye, tip of muzzle, lips, chin, and forethroat are white. The ears are cinnamon with slightly darker tips and whitish inner surface. The under-parts are white.

Four specimens have been examined from the crest of the Mau Escarpment near Ravine Station and two others from the German border near the Victoria Nyanza. The general tone of coloration in these skins is very light, notwithstanding the high, moist character of the country which they inhabit. Skins from the Nile match them quite minutely in general color tone. In British East Africa the roan are very local, being split up into small herds living in isolated bits of territory. The crest of the Mau Escarpment west of Ravine Station is the home of one of these herds. Another is stationed near Muhoroni, on the Uganda Railway, on the west face of the same escarpment, but much farther south and lower in altitude; still another herd haunts the region near the Ithangi Hills southeast of Fort Hall. A herd is also known to range from Sultan Hamound northward as far as Machakos by way of the Kui Hills. The greater number, however, are found in the Amala River drainage, on the German border, not far from the Victoria Nyanza. In this region many herds occur.

The measurements of the different sexes in the flesh show them to be of practically the same size. An adult male specimen measured in the flesh: head and body, 77 inches; tail, 25 inches; hind foot, 24½ inches; ear, 11½

inches. The horns of an average male are 25 inches long, those of a female about 20 inches. The record horns for East Africa, recorded by Ward, are 29⅜ inches. The largest male skull in a series of three measured 17¼ inches in length.

Nile Roan
Egoceros equinus bakeri

Native Names: Sudani, *abu araf;* Dinka, *anoum.*
Hippotragus bakeri Heuglin, 1863, Nov. Act. Leop. XXX, pl. II, p. 16.

Range.—Nile watershed from Uganda northward to the Atbara River and westward throughout the Bahr-el-Ghazal province, extending westward to the base of the Elgon highlands, west coast of the Victoria Nyanza, and northwest shore of Lake Rudolf.

Sir Samuel Baker met with the roan which now bears his name on the plains of the Atbara, in Kassala, and southward along the Abyssinian frontier as far as the Latooka or Acholi country in northern Uganda. He mentions in "Ismailia" the antelope as being new and compares it to the roan of South Africa, but the differences which he gave were merely fancied, the race really being scarcely distinguishable from the typical one. Heuglin, the describer of the race, had only seen the animal on one occasion in the field owing to the extremely local character of its distribution. The distinctness of the Baker roan has, indeed, been much overestimated, chiefly due to the ears having been described as fringed or tufted, a character which they do not possess. In the headwaters of the Bahr-el-Ghazal drainage the roan was recorded as early as 1870 by Doctor Schweinfurth and again some years later by Doctor Junker. The most eastern records are based on specimens obtained by W. N. McMillan's expedition to the Boma country northwest of Lake Rudolf, on the headwaters of the Sobat River.

In general shade of color this race closely resembles *langheldi* as well as the typical roan of South Africa. The whitish or buffy color of the front of the pasterns, the smaller size and lighter color of the dark chest patch, and the somewhat lighter ears alone serve to distinguish the race. The fringed or tufted character assigned to the ears has been found wanting in all the specimens examined. In

fact, some of the Nile specimens have the ears less tufted than average specimens of the other races. The horns average larger, however, in the Nile race. The record given by Ward is 37¼ inches for *bakeri*, while that of *langheldi* is, according to the same authority, only 29⅜ inches. An average length, however, for the Nile race is 21 inches. The longest horned female skull in the collection measures 23½ inches. Specimens of the Nile race, shot by Colonel Roosevelt and Kermit, have been examined from Nimule, Rejaf, and Gondokoro. The sexes are very similar in size. An adult male from Nimule measured in the flesh: head and body along curve of the back, 83 inches; tail, 25 inches; hind foot, 24¼ inches; ear, 12½ inches. The length of the skull of a large male is 17¼ inches.

Roosevelt Sable
Egoceros niger roosevelti

Native Name: Swahili, *pala-hala*.
Ozanna roosevelti Heller, 1910, Smith. Misc. Coll., vol. 56, pt. 4, p. 1.

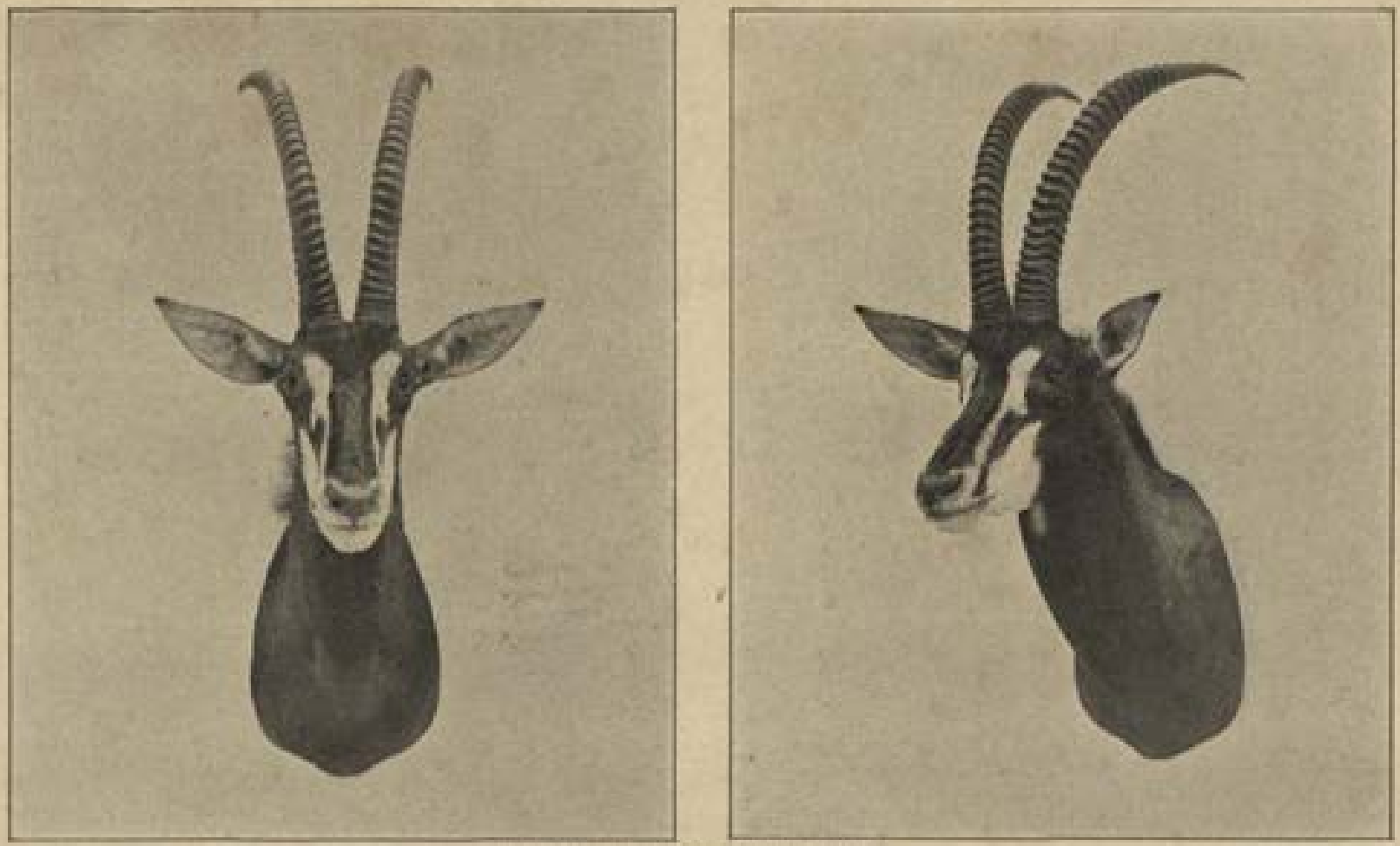
Range.—From the Shimba Hills near Mombasa southward along the coast to the Kigani River opposite Zanzibar Island.

The sable is the most magnificent and stately of all the antelopes, its only possible rival being the greater koodoo. In East Africa until recently it has been known to but very few sportsmen. It has, however, long been known on the evidence of native skins to occur on the coast opposite Zanzibar Island, but it is only recently that sportsmen have shot specimens. Sir John Willoughby was the first sportsman to report the species from British East Africa. He met with a herd in 1886 west of Maji ya Chumvi, but failed to secure any. Both Jackson and Percival have also met with herds near Maji ya Chumvi, but all the specimens which sportsmen have secured within the past three years have been shot in the Shimba Hills southwest of Mombasa a score of miles. The race was described from three specimens shot in the Shimba Hills by Kermit Roosevelt in 1909. The name *kirki*, given by Gray in 1872 to rufous individuals of the sable recorded by Sir John Kirk from the Zambesi, has been by some naturalists confused with the East African

race. Gray's name, however, was only based on the observations made by Sir John Kirk and was not founded on a specimen or a definite locality and does not apply to this race.

Kermit was the only one of our party who went into the sable country. He took a small safari thither from Mombasa and collected three specimens. The sable were not plentiful, and were shy. It was near the coast, a well-watered, hilly country, the rushing streams bordered by palms and the surface consisting of grassy plains varied by groves of trees and brushwood. It was hot and wet and the grass was long. The sable fed in the open plains until nine or ten in the morning, and then retired to the thick brush of the groves where they lay down until about five in the afternoon, when they again came forth to feed. They were grazers. One of those he killed, a full-grown cow, was very savage and tried to charge, but was too crippled to be dangerous. While resting during the day the animals, in spite of their conspicuous coats, were difficult to find or approach because they lay in cover so thick as to conceal them, and it required careful still-hunting to get them. In the plains they were, of course, very conspicuous, and their wariness made them hard to stalk. They went in little bands—they were not sufficiently numerous to gather in big herds.

The East African race of the sable may be distinguished from the typical race of the Zambesi basin by its much smaller size and more rufous coloration. The female is usually a bright rufous, seldom, if ever, assuming the black coat characteristic of the male, as she does in the south. The male is a decidedly smaller animal than the typical sable, with much smaller horns, the skull in the adult being



ROOSEVELT SABLE, ADULT MALE
From Shimba Hills, B. E. A.
Mounted by J. L. Clark

some two inches shorter, while the horns average more than twelve inches less in length. The black coat though assumed is less intense, only the tips of the hair being seal-brown with the basal part of the hair bright-rufous which shows through the coat readily when disturbed. In old males from Mashonaland the hair is uniformly dark seal-brown to the roots.

The general color of the male is seal-brown. The face has a median seal-brown stripe from the horn bases to the end of the snout, bordered on either side by a white stripe commencing above the eye, passing along a ridge in front of it where the hairs are somewhat longer, and running down to the upper lip; another seal-brown stripe runs from below the eye forward to the nose on either side, but the rest of the face, upper and lower lips, and chin are white. The crown of the head is like the back. The ears are white inside, tawny-rufous posteriorly and tipped with seal-brown. A dorsal mane runs from the level of the ears to the middle of the back. The belly, inside of upper part of hind legs, and rump are pure white, and sharply contrasted with the color of the back. The tail is seal-brown and ends in a long black tuft.

The female has the snout medially black from its tip to the base of the horns, the black separated from the rhinarium and horn bases by a narrow band of reddish-brown. A black stripe encloses the eye and extends from the base of the horns to the upper lip midway between the angle and the tip of the snout. The hairs covering the anteorbital area are creamy-white, set off from the rest of the face by their whiteness and greater length, and merging rather abruptly into the buffy stripe which extends forward to the tip of the snout. The cheeks and throat below the dark ocular stripe are whitish. The sides of the head and neck posterior to the eye, including the base and the outside of the ear, are light chestnut, like the general body color. The inside and margin of the ear conch are white, and the tip has short, dark-brown tufts. The whole dorsal region, including the head, is tawny-rufous, darkest dorsally, and slightly lighter on the sides, where it extends well down and is sharply defined against the white under-parts. The neck is clothed with a well-developed mane, which extends from the ears posteriorly to

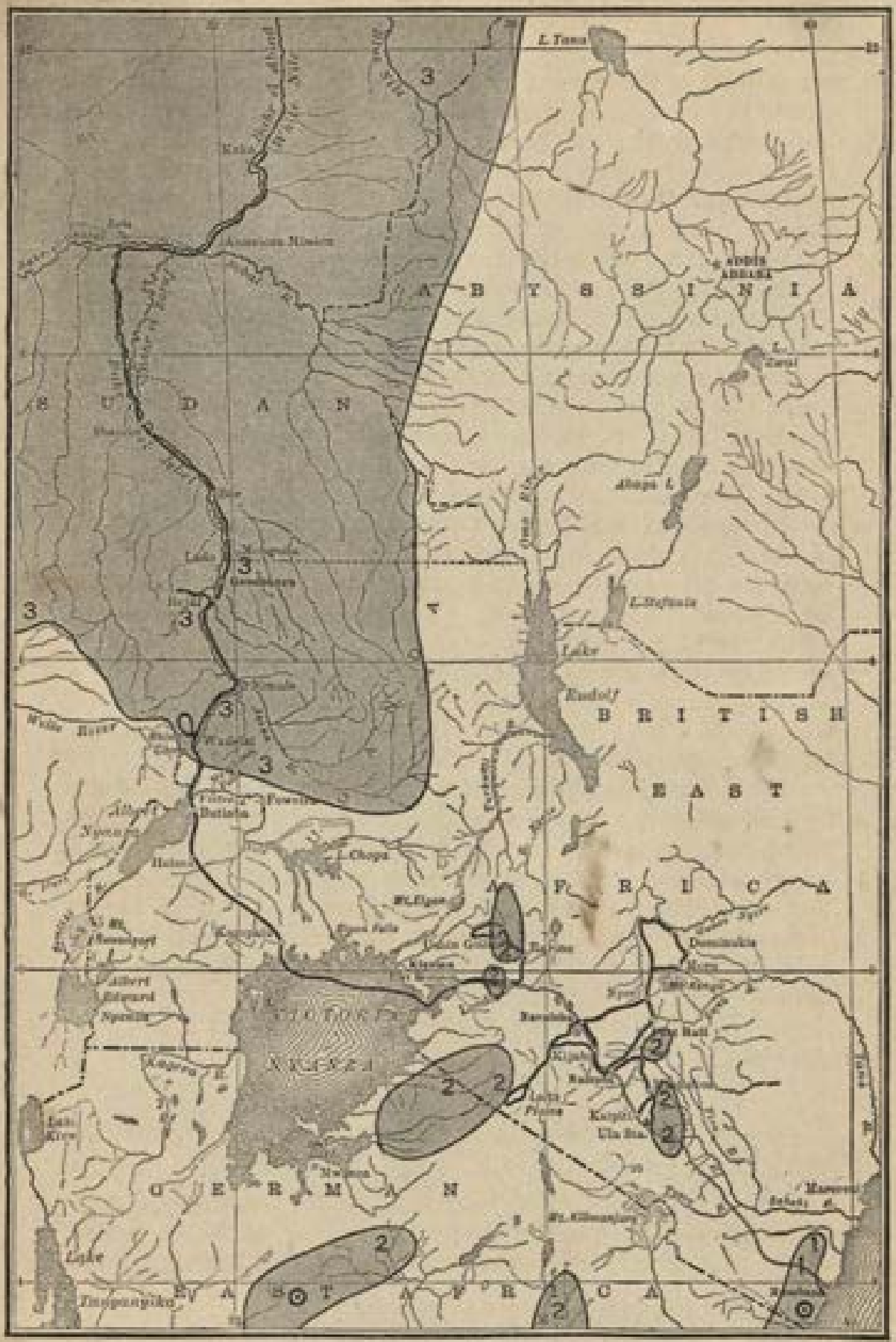
the middle of the back, the individual hairs black at base and tip, with the median third tawny like the back. The chest and lower throat are black, the black extending down the front of the forelegs as a broad stripe to the hoofs, where it spreads and embraces the pasterns and false hoofs; posterior part of forelegs colored like the upper parts. The hind legs are colored like the upper parts with the exception of the black bands above the hoofs embracing pasterns and false hoofs. The tail is black and well haired terminally, but the under side basally is brownish. The under-parts are white from between the forelegs posteriorly to the base of the tail and the lower rump, the white extending down on the inside of the thigh as far as the knee. The newly born young are quite different in color from the adults, the dorsal color being uniform ochraceous-tawny with a conspicuous seal-brown mane on the nape extending from the head to the withers. The tip of the tail, a band about the hoofs, and the back of the pasterns are also seal-brown or black. The under-parts and the back of the thighs are white. The head is marked by a large white blotch before the eye and a faint indication of the dark stripe through the eye. The tip of the muzzle is marked by a small black blotch, but the lips, chin, and forethroat are white. The ears are colored like the body with an indication of darker tips and are white inside.

No flesh measurements are available. The skull of the largest male examined measures 16 inches and is equalled by that of the female shot by Kermit Roosevelt. The horn length in an average male is about 32 inches. The longest horns recorded by Ward from British East Africa are 37 inches as against 54¼ inches for the record for the typical race. The horns of the only female examined measure 24 inches.

Oryx
Oryx

Oryx De Blainville, 1816, Bull. Soc. Philom., p. 75; type *O. gazella*, the gemsbok.

The oryx is at once recognizable by its long, slender horns projecting straight backward in line with the profile of the face, and by its high withers, striped face, and grayish



MAP 5—DISTRIBUTION OF THE RACES OF SABLE AND ROAN ANTELOPES

1 *Egocerus niger rooseveldi* 2 *Egocerus equinus langheldi* 3 *Egocerus equinus bakeri*

or whitish coloration. The tail is long and tufted, the false hoofs are well developed, and the lachrymal glands are absent. The skull is characterized by its short snout, distinct lachrymal-nasal sinus, and narrow cheek-teeth, which show only a rudiment of the internal accessory columns. Both sexes are horned, the horns being slightly more slender in the female, notwithstanding their greater length. The sexes are equal in size. The oryx is strictly a desert or dry-country antelope. It ranges from the deserts of Arabia and the Sahara southward to central German East Africa, and is found again farther south in the Kalahari Desert and in southern Angola. Four living species are recognized: the gemsbok of southwest Africa, the beisa of northeast Africa, the leucoryx of the southern Sahara, and the beatrix oryx of Arabia.

Two allied fossil genera have been described, *Protoryx*, with four species from the Upper Miocene of Asia Minor, and *Palæoryx*, with three Upper Miocene species from the same region, and four more recent Pliocene ones from Italy and Spain.

Beisa Oryx
Oryx beisa

The races of oryx assembled under beisa agree in having the head and body markings and the shape of the horns very much as in the gemsbok of southwest Africa. They, however, are readily distinguishable by the lack of the black rump patch, and the throat mane, as well as the much narrower extent of the knee bands and the obsolete character of the dark stripes on the cannon-bones. In the reduction of the black marking they show some approach to the more northern *leucoryx* and Arabian *oryx* which have lost both the dorsal and lateral stripes as well as the leg stripes. The beisa and its races inhabit the East Coast of Africa from the Red Sea port of Suakin south through Somaliland and Abyssinia to central German East Africa.

KEY TO THE RACES OF *beisa*

Ears not pencillate; hair whorl situated on the rump; body purer gray in color *annectens*

Ears pencillate; hair whorl situated midway between rump and withers; body usually with a brownish cast over the drab *callotis*

IBEAN BEISA ORYX
Oryx beisa annectens

NATIVE NAMES: Samburru, *sala;* Rendile, *ogorr.*
Oryx annectens Hollister, 1910, Smith. Misc. Coll., vol. 56, No. 2, p. 7.

RANGE.—From the Tana River, the northern slopes of Kenia and Lake Baringo northward throughout the desert and Lake Rudolf region to the Abyssinian border.

Specimens of this race secured on the Laikipia Plateau at the headwaters of the Northern Guaso Nyiro by John Jay White furnished Hollister with the material which led to the description of the race in 1910. The present race of the beisa had been collected some years previously by the elephant hunter Arthur Neumann as well as by other sportsmen, but these early specimens were considered by naturalists to be identical with the Abyssinian race *gallorum*, or else to represent true *beisa* of the Red Sea coast.

Oryx were plentiful along the Northern Guaso Nyiro. One of them, a bull, tipped the scales at four hundred pounds. They lived on the dry flats, both where there were open stretches of grass, and where they were covered with leafless thorn scrubs. They were found in small parties and herds of as many as fifty individuals. They also went singly or in couples; apparently the breeding cow stayed by herself until the calf was a few days old, when she rejoined the herd. We found a cow with a just-born calf, accompanied by a younger animal; the latter was probably the cow's young of the preceding year. In September all the calves

of the oryx along the Northern Guaso Nyiro were new-born. Old bulls were sometimes found alone, or associating with zebra herds; sometimes a couple of the old fellows would be found together, each doubtless turned out of his own herd by some vigorous master bull; and sometimes three or four young bulls would be found together, waiting until weight of body and length of horn might give them a chance each to master a herd for himself. The master bull keeps the rest of the herd in awe. Once we saw a bull, which had been shot at, gallop off several hundred yards with his herd, and then when the herd stopped, bawl or grunt loudly, and chase round two or three of his family in succession. Except on this occasion, we never heard an oryx make a noise, save for a kind of sneeze uttered by one animal when it saw us a hundred and fifty yards or so distant.

The oryx are grazers, but we saw one browsing. Although they can go for long periods without water, they drink every day or so when it is accessible. We found a herd watering at a bend in a stream at about noon, and another coming to the river to water rather late in the afternoon; and at water-holes in the desert oryx came to drink in the moonlight. In the heat of the day the herds sometimes feed, but are more apt to rest, either standing or lying; usually we found them resting under thin thorn-trees, but once or twice in cover that was fairly thick. Usually the herds we saw in the early morning and late afternoon were feeding, sometimes alone, sometimes in herds with one or the other species of zebra, once with a couple of waterbuck, once with some of the big gazelles. When either resting or feeding, the long tail is continuously switching; and this, even more than the vivid black and white mark-

ings, makes the oryx a conspicuous beast, unless so far distant that the only effect is that of his general coloration. When at a long distance, so that the movement of the tail does not catch the eye, and the effect of the black and white markings is minimized, the oryx is less boldly noticeable than the bonte-quagga and big zebra. At night, if sideways to us, they were rather less noticeable than the zebra, if either could be seen at all. Oryx are sleek, handsome beasts. We found them usually wary, difficult to approach, and trusting to their noses, but especially to their eyes, for safety. Yet, although ordinarily the oryx trusts to its eyesight, its eyes sometimes betray it; whereas its nose never does if it can get the wind of a foe. The sense of smell is usually the determining sense. Near the mouth of the Isiola River an oryx which showed extraordinary tameness was approached to within fifty yards. It remained gazing stupidly at the observer while he remained at this distance and in the same position, which was on the lee side of the oryx. Then he shifted his position to the windward so that his scent was carried to the antelope. As soon as it received this warning of the presence of a man it bolted to a safe distance. This sort of visual stupidity is, however, quite unusual. They are swift and enduring, but do not rank with the hartebeest in either respect.

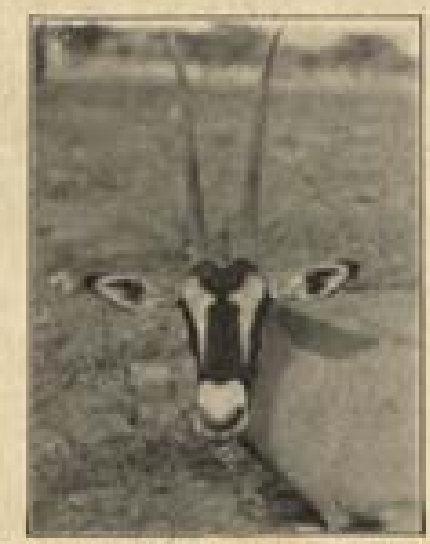
Oryx are bold fighters. The bulls use their horns chiefly for battle among themselves; but, as the cows have them also, it is difficult to believe that they have been developed solely for sex conflict. A wounded bull which we galloped down turned to bay and threatened a charge. It uttered a grunt so angry and menacing that it could easily be called a growl. It defends itself effectively against

hounds, and doubtless would do the like against wild beasts if given the chance. It is said on occasions to beat off the lion. We saw nothing to indicate that such a feat, if it ever occurs, is usual. The lions along the Northern Guaso Nyiro were killing oryx and zebra indifferently, and there was nothing in the record left by and around the carcasses to show that there was more of a struggle in one case than in the other. The lion's attack is normally a surprise, a furious rush at close quarters, and a grapple before the quarry has a chance to flee or fight; and once he has hold, especially if one paw is on the head or neck, the chance for resistance from an antelope no bigger than an oryx is at an end. Moreover, the antelope's aim is to escape, not to fight. The lion's life—that is, his dinner—depends on his killing the antelope; whereas the antelope's life depends, not on his killing, but on his escaping from the lion; so that the antelope's whole energies are bent on getting away, and unless this is impossible he makes no fight. If a cow with a very young calf discovered a lion in time she might oppose the beast, and then, being on her guard, her lance-like horns might make it very dangerous for her assailant.

The Ibean beisa oryx is somewhat intermediate between the Abyssinian beisa and the fringed-eared oryx. It may be distinguished from the former by its much grayer color, which lacks the vinaceous or pinkish wash, and by the gray of the sides extending below the black lateral line, the latter not forming the boundary between the white under-parts and the gray sides. From the fringed-eared oryx it may be distinguished by its grayer coloration, lack of pencillate or tasselled ears and posterior situation of the dorsal hair whorl on the rump. The dark head markings are variable. Usually the dark preocular stripe terminates freely without joining the dark face blaze or the throat stripe,

IBEAN BEISA ORYX, MALE
Shot by Theodore Roosevelt
Northern Guaso Nyiro, B. E. A.

IBEAN BEISA ORYX, MALE
British East Africa



IBEAN BEISA ORYX, FEMALE
Shot by Paul J. Rainey
Northern Guaso Nyiro

FRINGED EARED ORYX, MALE
Taita District

IBEAN ORYX, MALE
Shot by Theodore Roosevelt
Northern Guaso Nyiro, B. E. A.

IBEAN BEISA ORYX, FEMALE
Shot by Paul J. Rainey
Northern Guaso Nyiro, B. E. A.

IBEAN BEISA ORYX
Northern Guaso Nyiro, B. E. A.

FRINGED EARED ORYX, MALE
Shot by Dr. L. W. Abbott
near Taveta, Kilimanjaro Region

SHOWING INDIVIDUAL VARIATION IN HEAD MARKINGS IN THE BEISA ORYX

but in some specimens it unites at its tip broadly with both the black face blaze and the mandibular stripe to form a solid dark ring about the muzzle near the tip, as is characteristic of the South African gemsbok.

Both sexes are alike in coloration. An adult male is uniform écru-drab on the dorsal surface, with the median dorsal region marked by a broad black stripe from the withers to within six inches of the base of the tail. The lower sides are marked by a broad lateral stripe extending from the knee band along the lower flanks to the hind quarters, the stripe being widest posteriorly. The gray of the sides borders the band below for a few inches where the color merges gradually into the white under-parts. The forelegs are white, marked with a broad band above the knee and a narrow blackish streak on the front of the cannon-bone. The false hoofs are narrowly bordered by black hair. The hind limbs are vinaceous-drab, changing to white below the hocks, and the false hoofs are bordered by black hair. The posterior part of the limb below the hocks is marked by an ill-defined blackish stripe. The under-parts are white from the chest to the base of the tail. The tail at the base is drab like the back and the tip has a long bush of black hair. The neck is colored like the body and furnished on the nape with a short mane. The median line of the throat is marked by a broad black stripe from the head to the breast, where the stripe forks and joins the lateral bands. The head is strikingly marked black and white, the crown being black, bordered by a cream-buff band on the forehead from the horn base across to the interorbital region, but narrowly separated by a tongue from the black face blaze. The front of the face, except the snout, is covered by a broad black blaze reaching well down on the sides, but not extending nearer than halfway to the tip of the snout. A broad dark streak extends through the eye from the base of the horn to the angle of the mouth and is separated from the face blaze by a wide streak of white. The snout, chin, and forethroat are wholly white. The back of the head is drab. The ears are drab, the tips for an inch being marked by blackish hair, and the inside of the ear by white. A wide dark stripe extends from the base of the ears downward and joins the dark median throat stripe. The nursing young are very different from their parents in

color, being quite without the dark color markings, the dorsal coloration being uniform cinnamon-buff, only the tip of the tail and a blotch above the knees black. The extreme tip of the ears is dark-brown, and the eye region has a faint indication of the dark diagonal streak. The snout is dark seal-brown. The belly and the under-parts are buffy like the sides. There is no indication of the dark dorsal, flank, or throat stripes or face blaze, and the tip of the snout, which in the adult is white, is quite dark seal-brown. The head and the body stripes in the adults show much individual variation. In a series of ten skins from the Northern Guaso Nyiro only six have the dark preocular stripe free at its tip from the face blaze or the gular stripe; in two of the others the preocular stripes are fused with the face blaze where it terminates on the snout, and in the last two they are confluent with the dark gular and throat stripe, a condition characteristic only of the gemsbok of South Africa. The dorsal stripe also shows much variation, being quite obsolete in one-half of the skins. The flank band is always present but varies much in width.

The flesh measurements of a large male are: head and body, 67 inches; tail, 18½ inches; hind foot, 20 inches; ear, 8 inches. The females measured show practically the same dimensions. The females, as a rule, exceed the males in length of horns, but their horns are usually more slender and distinctly thinner at the base. In a series of twenty in the National Museum, however, the longest horns are those of a male, and are 33 inches in length; the longest female horns being 32 inches. The basal circumference of the male horns is 7 inches as against 5½ inches for the female. The longest male skull, however, is exactly equalled by the longest female skull, the dimension being 15¼ inches. The maximum horn length given by Ward for an East African beisa is 38 inches. Both the true beisa and the fringed-eared have smaller horns than the present race.

The specimens examined by the writers have all come from the Northern Guaso Nyiro drainage, ranging from the headwaters on the Laikipia Plateau as far down as the Lakiundu junction, and thence northward to Mount Marsabit. Northward *annectens* no doubt merges into *gallorum* at the north end of Lake Rudolf, but southward it

MAP 6—DISTRIBUTION OF THE RACES OF THE ORYX

1 Oryx beisa callotis *2 Oryx beisa annectens*

does not mix directly with *callotis*, being separated from the latter by the Tana River and the highland barrier of Mount Kenia and the Aberdare Range. The northwestern limits are McMillan's records from the Boma country northwest of Lake Rudolf, which he was the first to explore.

Fringed-Eared Oryx
Oryx beisa callotis

Native Name: Swahili, *cheroa.*
Oryx callotis Thomas, 1892, Proc. Zool. Soc., p. 195, colored plate XIV.

Range.—The desert district from the Tana River south to Kilimanjaro and thence west to the Rift Valley, ranging from Mount Suswa south to central German East Africa as far as Ugogo.

The fringed-eared oryx is one of the numerous races discovered by Rowland Ward among the trophies sent to his establishment by sportsmen. He pointed out to Thomas the peculiar character of its pencillate ears; and upon further investigation it was described, and the specimen which came from Kilimanjaro presented to the British Museum. This oryx was well known to the early sportsmen who visited Kilimanjaro previous to 1892, particularly to Jackson, Willoughby, and Abbott, under the name of beisa.

This species resembles in coloration and markings closely the Ibean beisa oryx, from which it may be distinguished by its tasselled or pencillate ears and the more brown or fulvous suffusion of its coat. The face markings are similar to those of the Northern Guaso Nyiro race, the preocular stripe usually showing no connection with the face blaze or the throat stripe. Variations, however, no doubt occur in which this stripe joins the face blaze or the throat stripe, although, in the few specimens examined, no such variations were seen. The body color is also variable, and in some specimens it is quite as gray as in the more northern beisa; but the race may always be distinguished by its fringed ears.

No flesh measurements are available, but, judging by the size of the skull, this race is practically the same size as the Northern Guaso Nyiro race. The skull of an adult female measures 15¼ inches in greatest length. The tooth row is,

however, longer than in *annectens* and is, no doubt, one of the distinguishing characters of the race. The horns of an adult female collected by Doctor Abbott are 29½ inches long, which is only a few inches less than Ward's record of 33½ inches for the race.

The fringed-eared is a much more local race than the northern. It is found locally near the Taita Hills, near Lake Jipe, at Useri on the east slope of Kilimanjaro, near Makindu on the Uganda Railway, again far eastward on the coast at Merereni. In the Rift Valley it is found just south of Mount Suswa in the latitude of Nairobi, again at Lakes Magadi and Natron, and thence in isolated localities in German East Africa at Lake Manyara and in Ugogo, where it reaches its extreme southern limit.

CHAPTER XIII

WILDEBEEST, DAMALISCUS, AND HARTEBEEST

Subfamily *Bubalinæ*

The *Bubalinæ* include some of the most grotesque and specialized antelopes as well as some comparatively generalized types. In affinities they are closely related on the one side to the egocerine antelopes or sables through the genus *Damaliscus* and on the other to the African buffalo through the wildebeest, *Gorgon*. The hartebeests are a highly specialized genus and represent the extreme diverging branch of the *Bubalinæ* tree. The characters which are common to this somewhat diverse assemblage are the elongate head, especially the snout region, which has very long nasal bones; the high withers; the long, tufted tail; the presence of horns and of two mammæ in the female; the rudimentary condition of the anteorbital gland, and the narrow ears. The members are all grazers and are primarily open-plains antelopes possessing great speed. The group is apparently of more modern origin than either the egocerine or tragelaphine antelopes. The oldest members recorded have been found only as far back as the Pliocene of India. More recent species of hartebeests have been discovered in Pleistocene deposits in South Africa.

Key to the Genera

Skull not markedly elongate, the horn bases never united into a pedicle

Horns buffalo-like in shape, curving downward from the base and extending outward at right angles to the head; nape and throat maned; muzzle broad *Gorgon*

Horns not curving downward from the base but directed backward and upward; neck without mane; muzzle normal

Horns curved backward and upward; tail tuft black; lower premolar teeth three *Damaliscus*

Horns curved outward and then parallel, forming a U, and greatly exceeding the head in length; tail tuft white; lower premolar teeth two *Beatragus*

Skull elongate, the horns united at the base to form a pedicle which is produced backward beyond the rest of the skull *Bubalis*

Damaliscus

Damaliscus

Damaliscus Sclater and Thomas, 1894, Book of Antelopes; type *D. pygargus*, the bontebok of South Africa.

The genus *Damaliscus* is an assemblage of four very distinct species of hartebeest-like antelopes, comprising the bontebok, blesbok, sassaby, and topis. There is, unfortunately, no general term in use among sportsmen for these four species, each of which bears a distinct name, and the only way of supplying this deficiency appears to be the adoption of the generic name as a common English term for the group. The damaliscus have the high withers of the hartebeest, but the head is less elongated and the horns are not united in a pedicle at the base but rise independently above the orbits as in the sable and roan antelope. The horns are heavily ringed and curve evenly backward as in the roan with the exception of the tips which are deflected slightly upward. The horns are much shorter than those of the roan and are never curved in a semicircle, their general direction being upward or backward in line with the profile of the head. The close relationship of the damaliscus antelopes to the sables and roans is obvious on the comparison of skulls in the structures of which there is close agreement in the shape of the bones, the absence of sinuses, and the slight development of the anteorbital fossa. The cheek-teeth of the damaliscus, however, are much narrower and less folded than those of the egocerine antelopes. The genus is most highly developed in South Africa, in which region three distinct species occur. North of the Zambesi watershed we find only one species, *D. korrigum*, occupying a wide range of territory from the East to the West Coast as far northward as the southern border of the Sahara Desert and the Abyssinian highlands. A single fossil species is known from the Pleistocene of India.

Equatorial Damaliscus

Damaliscus korrigum

Included under the term equatorial damaliscus are the three races known to sportsmen as the korrigum, tiang, and topi. They are very closely related and scarcely distinguishable notwithstanding their diverse geographical ranges, which are accompanied by considerable local isolation. Formerly these three forms were considered as species and distinct names were applied to them under the assumption that they were quite distinct. Owing to the scarcity of specimens in museums for comparison the real differences in these forms have remained unknown. It has recently been found that they are subject to a considerable degree of variation in their black color markings which renders the characters upon which the old species were based void. *Damaliscus korrigum* has the coloration and body size of the sassaby of South Africa from which it is distinguishable by decided differences in the shape of the horns. In the sassaby the horns spread outward from the head in a wide curve, somewhat as in the tora hartebeest, and then curve inward at the tips and are never parallel or gradually divergent backward as in the korrigum. The equatorial damaliscus inhabits the territory south of the Sahara Desert and the Abyssinian highlands from the Tana and Juba Rivers on the East Coast westward through the Nile Valley and Lake Chad watersheds to the West Coast and Senegal region. Three geographical races may be recognized, the topi in the east, the tiang in the central region, and the korrigum in the west.

Key to the Races of *korrigum*

Coloration lighter, cinnamon; pelage shorter; horns longer, averaging 3 inches more in length — *tiang*

Coloration darker, cinnamon-rufous; pelage longer and heavier; horns shorter — *jimela*

Tiang Damaliscus

Damaliscus korrigum tiang

Native Names: Djeng, *tiang;* Bongo, *tanghe.*

Damalis tiang Heuglin, 1863, Ant. u. Buff. N. Ost. Afr. (N. Act. Leop. XXX, pt. II, p. 22, pl. I, col. fig. head).

RANGE.—From the Albert Nyanza northward through the lowlands of the Nile Valley to the Blue Nile, eastward as far as Lake Rudolf and westward to the limits of the Bahr-el-Ghazal drainage.

Von Heuglin in 1863, in his account of the antelopes and buffaloes of Northeast Africa, described the tiang damaliscus as new, giving it the native Djeng name of *tiang*. He states that this species is very abundant in the country of the Djeng, who occupy the territory between the Bahr el Zeraf and the Sobat River near its junction with the White Nile. It is a widely distributed animal in the Nile Valley and has been met with by such early explorers as Schweinfurth, Baker, Emin Pasha, and a host of recent sportsmen and travellers.

The tiang differs very slightly from the topi of East Africa, and is distinguishable from it with difficulty. The general tone of the coloration is lighter, being cinnamon, and less reddish than that of the topi, but the black markings of the head and legs are quite identical in extent. The hair covering on the coat is somewhat thinner and shorter. The horns are distinctly longer and average some three inches greater in length. No specimens representing the tiang are in the collection of the National Museum, but specimens from the Nile Valley have been examined at the British Museum. A series of specimens is greatly needed to show the limits of variation in coloration and skull characters of this race.

TOPI DAMALISCUS

Damaliscus korrigum jimela

NATIVE NAMES: Swahili, *topi;* Unyamwezi, *jimela.*

Damalis jimela Matschie, 1892, Sitz.-Ber. Nat. Freunde, Berl., p. 135.

RANGE.—From Mount Elgon and the northern highlands of Uganda southward over the Mau Escarpment and Victoria Nyanza drainage to central German East Africa; westward as far as the Edward Nyanza and Lake Kivu; also near the coast from the Sakaki and Tana Rivers northward as far as the Juba River.

Sir John Kirk, the British consul-general at Zanzibar,

to whom we are indebted for the earliest accounts of the game animals of East Africa, met with the topi as early as 1866 on the plains near Merereni and also at the mouth of the Tana. Jackson, Harvey, and Hunter a score of years later recorded the topi in the same district. At this time it was held to be identical with the korrigum and called, accordingly, the Senegal hartebeest. In 1892 Matschie described the topi as a new species, *Damalis jimela,* basing his description on a pair of horns from the southeastern shore of the Victoria Nyanza and a painting by Richard Böhm of specimens from central German East Africa. None of the color characters given by Matschie apply to his race, but the horns may be taken as representing the race. More recently, in 1907, Lydekker renamed the race, *selousi,* on specimens from the Uasin Gishu plateau. Still more recently another name, *phalius,* has been applied by Cabrera to a white-faced specimen from the same plateau shot by Señor Huerta. This specimen represents an abnormal or extreme type of individual variation of the topi. Occasional specimens are found in East Africa marked by a whitish or buffy face blaze and showing a tendency toward the white face blaze of the closely related blesbok and bontebok of South Africa. The topi resembles closely the tiang in coloration and proportions, but may be distinguished by its darker cinnamon-rufous coat, longer pelage, and smaller horns. From other East African antelopes it differs conspicuously by the silvery sheen of its coat which gives it a resplendent effect very similar to that of watered silk.

The topi offers almost as conspicuous an instance of disconnected distribution as the square-mouthed rhinoceros. In East Africa it is abundant along the seacoast in certain regions; and in the western part of the country it is abundant in certain regions. From the regions between it is totally lacking, although to all outward seeming they are physically of precisely the same character. Moreover, animals of the same or very closely allied species or subspecies are found in regions along the White Nile and in

the Abyssinian neighborhood; and yet here again there are great stretches of similar territory in between in which they are not found at all. The problem is all the more puzzling because the topi is often very plentiful where it exists at all; if it was everywhere rare, it would be easy to understand why it might have died out in certain places. It is another instance of how very much we yet have to learn from the book of nature. Many of the problems connected with the distribution and abundance of African antelopes are, with our present knowledge, insoluble. Compare, for instance, the distribution of the roan antelope—treating the various forms together—and the topi—also treating the various forms together. The topi is usually abundant wherever found at all; the roan is usually much less abundant where it is found. The roan is at home in surroundings as diverse as if they were in different zones and different continents. We found them among the cold, wet mountains, south of the Uasin Gishu, where a moose would have found the climate entirely congenial, and also on the hot, parched flats of the Lado, with a vegetation as utterly different as was the climate itself. Yet there are vast reaches of country from which it is entirely absent; and we never came across it in such abundance as we often found the topi. The topi kept everywhere to country of substantially one kind; and yet, for no apparent reason, its distribution in this kind of country is narrowly and irregularly limited. It abounded in company with one kind of hartebeest on the Loita Plains, and in company with another kind on the Uasin Gishu; but it was absent from precisely similar country—as the Athi Plains—on which one or the other of the hartebeests swarmed. The roan, except for its face markings, is on the

whole concealingly colored. The topi is one of the most conspicuously colored of all the antelopes, being inversely countershaded. Only the wildebeest and the old bulls of the sable, Nile lechwi, and white-eared kob have a coloration more clearly advertising. Yet the difference in coloration is evidently of not the slightest consequence as regards any effect on the respective life histories of the two animals; wherever found at all, the highly conspicuous topi—which is advertisingly colored under practically all conditions—is much more plentiful than the roan, whose coloration really does have a certain concealing value under certain circumstances. But neither trusts to concealment at all when on the plains, and while the roan in certain places in the woods may make use of cover to conceal itself the topi never does at all. The topi is almost as conspicuous as a wildebeest; in its haunts only a wildebeest would be observed farther off, and it never seeks to escape observation, trusting purely to its vigilance and its sense for safety.

In its habits, as in its outward appearance, the topi is a somewhat less violently accentuated hartebeest—just as in the wildebeest the characteristic habits and aspect of this group of antelopes reach their most extreme and eccentric expression. The topi frequents precisely the same type of country as the hartebeest, when the two are found in the same locality, and it grazes, it rests, and goes to water—in places at stated times, in others at irregular intervals—just like its congener. Often I found herds of the two species intermixed, and often other game, such as wildebeest, zebra, and gazelle, were with them. Often herds would be found exclusively of one species. We have seen a couple of hundred topi in a herd; and small parties and single bulls are

TOPI DAMALISCUS, MALE
Shot by Theodore Roosevelt, Lolta Plains, B. E. A.
United States National Museum, Washington, D. C.

TOPI DAMALISCUS, MALE
Shot by Theodore Roosevelt, Lolta Plains, B. E. A.
United States National Museum, Washington, D. C.

TOPI DAMALISCUS, ADULT MALE
Uasin Gishu Plateau

MOUNTED SPECIMENS OF THE TOPI DAMALISCUS

also common. Like the hartebeest, the topi often stands on ant-hills to watch and look round. In places we found the topi shyer than the kongoni, and in places both were tame. The topi is said to be an even swifter and more enduring runner than the kongoni. However this may be, it is certainly both swift and enduring, and it is, morever, very agile; when a herd is suddenly alarmed the individuals spring clear over one another's backs in the hurry and confusion, and on one such occasion we saw one jump over an ant-hill higher than a man's head. The bulls fight fiercely among themselves. On the Uasin Gishu plains we saw a big herd of topi one of whose members had a white face like the South African blesbok.

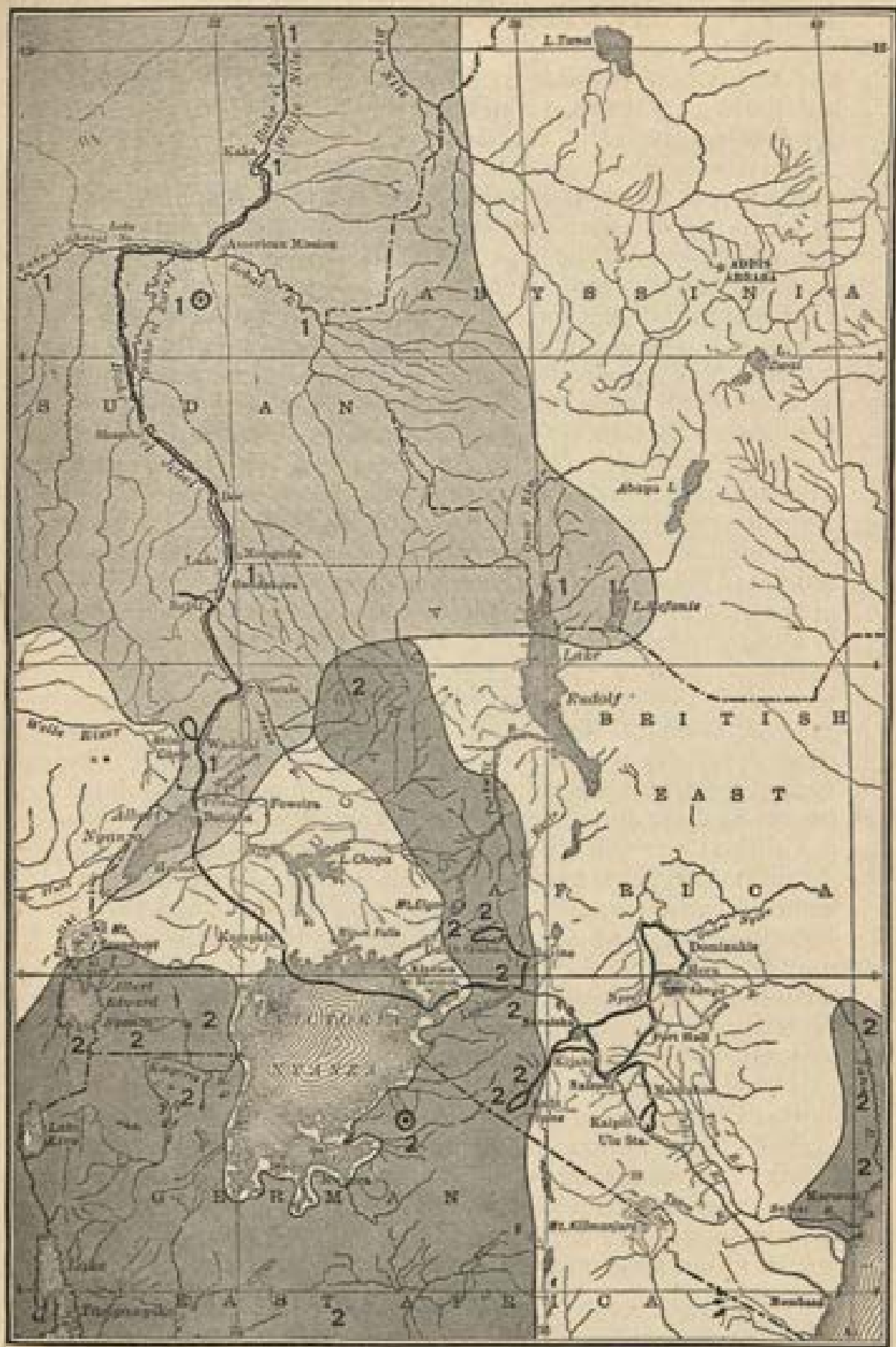
There are few more beautiful sights than a herd of topi seen close by in the bright sunlight of the great African plains. They are not ungainly, like the hartebeest, and their coats are not only beautifully colored but have in life a wonderful iridescent sheen; the muscles ripple beneath the satin skins, and every movement shows lithe and abounding vigor.

A topi bull weighs two hundred and eighty or three hundred pounds; a cow twenty or thirty pounds less. In spite of its usual wariness, the topi is subject to fits of silliness and curiosity that expose it to reckless slaughter by rifle-bearing hunters. It is very tenacious of life, and will go long distances after receiving what would seem to be crippling wounds.

The body coloration is a bright cinnamon-rufous overlaid everywhere by a silvery sheen which gives the coat a resplendent effect. The red color is deepest on the head, throat, and sides and lightest on the rump, hind quarters,

and tail, where it fades to pure cinnamon. The shoulders are marked by a broad black patch which extends down on the forelegs as far as the knees and completely circles the upper part of the leg. The hind quarters are marked by a much larger black patch which extends down on the limbs as far as the hocks above which it forms a complete band around the leg. The legs below the knees and hocks are uniform tawny, the color being slightly deeper in front than behind. Some specimens show a median, narrow, walnut-brown stripe on the back of the pasterns. The terminal half of the tail is furnished with a long tuft and crest of black hair. The under-parts are cinnamon-rufous, like the dorsal surface, with the exception of the groins, the posterior part of the belly, and the axillæ, which are buffy. The dorsal surface of the head from the crown to the muzzle is deep-black in color as far down as the level of the eyes. The sides of the head and throat are a deep-bay or blood-red color, which is sharply defined against the black. The upper lips and the chin are tawny. A black stripe or bar is usually present below the eye, extending from the black snout patch to behind the eye. Often this bar is absent or represented only by a spot below or behind the eye. Situated in front of the eye is the rounded anteorbital pore surrounded by a narrow band of black naked skin. The backs of the ears are tawny, with the terminal third walnut-brown and the inner side white. The sexes are identical in coloration, but the newly born young differ widely in color. At first they are a uniform light-fulvous or buffy-ochraceous, very much the color of sable at the same age. This lighter color, however, is soon lost and the cinnamon coat and black leg patches assumed. The black face blaze lags somewhat behind the leg markings and is buffy and only indistinctly indicated until the budding horns have reached at least four inches in length.

An adult male topi shot by Colonel Roosevelt on the Loita Plains measured in the flesh: head and body, 67 inches; tail, 19 inches; hind foot, 22 inches; ear, 8 inches. These dimensions represent well the average in males, but the females are considerably smaller, the length being some 4 inches less and the hind leg 1 inch less. The skulls of the males range in length from 15 to 15¾ inches. The horns


SUDAN
ABYSSINIA
BRITISH
EAST
AFRICA
Lake Rudolf
Abaya L.
Stefanie L.
Chew Bahir
Dembidolo
Kaffa
Kibbe
Gore
Jimma
Ghimirra
Kaffa
Kullo
Kullo
Kullo

of the males are decidedly heavier or thicker than those of the females and are slightly longer as well. They do not, however, vary much in size. The large series in the National Museum range from 13 to 17¾ inches. Ward records a specimen 19¼ inches in length from East Africa.

A large series, some thirty specimens, have been examined in the National Museum, from the Loita Plains and Uasin Gishu Plateau. Much variation in the black stripe below the eye is shown by this material, in fifty per cent of which it is quite absent or only indicated by a spot behind the eye. Several of the specimens show a tendency toward a white face blaze. In one specimen from the Loita Plains there is a strong intermixture of white hair throughout the whole black face blaze, while in others this mixture is confined either to the tip of the snout or the forehead between the horn bases. The topi has been reported from southwestern Uganda in the Ankole district by Delme-Radcliffe and in Buddu by Gedge. This elevated portion of Uganda marks its extreme northwestern range in the Nile watershed.

Hunter Antelope

Beatragus

Beatragus Heller, 1913, Smith. Misc. Coll., vol. 60, No. 8, p. 8; type *Damaliscus hunteri.*

The Hunter antelope, owing to its peculiarities of body form and horn shape, has recently been separated from the genus *Damaliscus* and named *Beatragus* by Heller. In the elongate shape of the snout it approaches the hartebeest, but the occipital portion of the skull is rounded as in the damaliscus antelopes and not overhung by a horn pedicle. The horns arise independently behind the orbits, curve outward, and then slant upward and backward, extending parallel in direction for the greater part of their length. Viewed from the front, they are broadly U-shaped and quite impalla-like in general shape and size. They are ringed on the basal two-thirds of their length, the tips being smooth and acutely pointed. The first lower premolar tooth is usually wanting, the cheek-teeth of the lower jaw numbering but five on a side. *Beatragus* differs from the hartebeests

and damaliscus further by the white tail tuft and the white bar across the forehead between the eyes. The body form is more slender than that of the hartebeest and the withers are lower. The Hunter antelope is the sole representative of the genus, which is restricted in range to a small area of park-like or plains country on the north side of the Tana River. It is doubtless a specialized offshoot of damaliscus and not an intermediate connecting link between the hartebeest and the latter.

Hunter Antelope

Beatragus hunteri

Native Name: Galla, *herola.*
Damalis hunteri Sclater, 1889, Proc. Zool. Soc., pp. 58 and 372, pl. XLII.

Range.—North side of the Tana River from the village of Durani up the river as far as Massa at least, that is, from a point seventy miles inland to about one hundred and twenty miles up the river. North of the Tana River it extends parallel to the coast as far as the latitude of Port Durnford.

Hunter was undoubtedly the first sportsman to meet with the species which was named for him by Sclater. During a sporting trip in 1887 on the lower Tana River he shot the first specimen near the village of Durani, which is some one hundred and fifty miles from the mouth by way of the tortuous river channel but actually only seventy miles in a direct line. He recognized the antelope as new, and carefully preserved, and photographed the first specimen he secured. Farther up the river they were met with in greater numbers as far as Massa, at which point the hunting party turned back to the coast. Hunter's specimens have for many years remained unique in the British Museum, but recently two others were added by Gilbert Blaine, who obtained them on his way down the Tana on the north side near Hunter's original locality. Two other specimens have been examined at the Nairobi Club in British East Africa, which were obtained by Major H. J. Kirkpatrick on the Tana River. Owing to the isolated and restricted nature of its habitat, less than half a score of sportsmen have met with this antelope.

The dorsal color is a uniform ochraceous-tawny without any indication of a lighter rump patch. The distinctive color marks are the white tuft of the tail and the white band across the forehead between the eyes. The underparts are whitish or light-buffy and the ears show dark tips with white inner surfaces. The sexes are alike in color. The coloration of the young is not recorded, but it doubtless closely resembles that of the adult.

Hunter met with this antelope on open, grassy plains bordering the Tana, in herds of fifteen to twenty-five individuals. He also found them occasionally in scattered bush country. They were met with occasionally along the river throughout a stretch of about one hundred miles bordering the north or east bank but were local in distribution, owing to the interrupted character of the plains country.

No flesh measurements are recorded. The body size is somewhat less than that of the Coke hartebeest. The skull of the type measured $12\frac{9}{16}$ inches in basal length by $5\frac{2}{16}$ inches in greatest breadth at the orbits. The horns of the male exceed somewhat in length and size those of the female. Ward records the horn measurements of six male and two female specimens. The males in this series average 24 inches in length, with a spread at the tips of 13 inches. The largest pair are 26½ inches long, the widest spread at the tips 15½ inches. The largest female pair measure 21¼ inches in length by 11 inches in spread at the tips.

Brindled Wildebeest

Gorgon

Gorgon Gray, 1850, Proc. Zool. Soc.; type *G. taurinus.*

The brindled wildebeests show marked differences in shape of skull and horns from the white-tailed gnu, and the two cannot with propriety be grouped together under the same genus, as is commonly done. The snout in the brindled wildebeest is long, the nasal bones being two-thirds the length of the skull; the orbit is small and without a bony ridge below it; the premaxillary bones are rounded at their tips and the lachrymal bone has a shallow hollow or fossa in front of the orbit. The white-tailed gnu has a

short snout, the length of the nasal bones being only one-half that of the skull; the orbit is large and has a ridge below it; the premaxillary bones are square at their tips with angular corners, and there is no evidence of an anteorbital fossa in the lachrymal bone. The horns of *Gorgon* are lateral in direction while those of *Connochætes*, the type of which is the white-tailed gnu, curve forward over the eyes and then upward and backward. The two wildebeests have furthermore marked differences in the body shape. The brindled is quite bison-like, with enlarged shoulders, high withers, and small hind quarters while the gnu has enlarged knobbed hips and comparatively small shoulders or withers. In general shape the skull of the brindled wildebeest approaches more closely that of the African buffalo than the gnu. It is distinguishable from the buffalo only by the difference in horn shape and narrower cheek-teeth. It is remarkable how closely the bones of the snout of these two members of the *Bovidæ* agree in shape and proportions. The brindled and the white-bearded wildebeests are the sole representatives of the genus *Gorgon*. They range throughout eastern Africa from the Vaal River, the northern affluent of the Orange, to the Athi Plains of British East Africa.

White-Bearded Wildebeest

Gorgon albojubatus

The white-bearded wildebeest is distinguishable from the brindled species, as its name signifies, by the white or light color of its throat mane. There is no other important or obvious difference, both species having similarly dark bodies which show a tendency to dark cross bands due to a worn or ragged condition of the hair along transverse streaks. Owing to the absence of specimens which show an intermediate coloration of the throat mane between the black of the brindled and the white or buffy of the white-bearded, the latter must be considered a distinct species. The white-bearded is the northern representative of the brindled wildebeest type and ranges from central German East Africa northward to the southern slopes of Mount Kenia in British East Africa.

With the single exception of the nearly extinct white-tailed gnu of South Africa, the common African gnu or wildebeest is psychically—and therefore in all its life habits—the most interesting and original of all African ruminants. It is as totally different in conduct as in aspect from all other antelopes. In its temper it has something both of the ferocious and sinister and of the queer and freakish, the eccentric and fantastic. It is by nature an extremely savage creature. When tamed it becomes excessively dangerous as it grows old, attacking with mortal fury every human being, from sheer homicidal anger and lust for death and mischief. When wild it will charge if cornered or close pressed when wounded. But its moderate bulk and blunt horns furnish it with bodily weapons so poor as to render it entirely helpless when assailed by either lion or man, and knowledge of this bitter fact prevents it from ever venturing combat with either of its great foes. It is as wary as it is curious and ferocious, and no animal is harder to approach on the bare, open plains where it dwells. It is unusually noisy for an antelope, continually uttering its short grunt.

Where we saw the wildebeests, at the extreme northern end of their range, they were exclusively beasts of the open plains. We rarely saw them even in thin thorn scrub into which the hartebeests not infrequently ventured. Only the gazelles were equally persistent in shunning cover and in keeping to the grassy flats. It may be that elsewhere the wildebeests venture more freely into thin, dry scrub. But everywhere the animals are so conspicuous that they make not the slightest effort to hide or escape notice. Owing to its size—a big bull weighs from five hundred to six hundred pounds—and its dark coloration, which seems

LOITA WHITE-BEARDED WILDEBEEST, MALE

Loita Plains, B. E. A.
From a photograph by Kermit Roosevelt

WHITE-BEARDED WILDEBEEST

From German East Africa In the New York Zoological Park

WHITE-BEARDED WILDEBEEST

black at a distance, the wildebeest is more quickly seen, and at a greater distance than any other game below the rank of the "heavy game," as the Boer hunters call the elephant, rhino, giraffe, and buffalo. Its one object is to keep in such a position that it can itself see its foes; it does not in the least mind being seen by them. It is extraordinarily tough and tenacious of life, paying amazingly small heed to what would seem to be crippling wounds; and it has great speed and endurance. Indeed, it is probably the speediest of East African antelopes in a long run. The cowboys of the Buffalo Jones party were unable to run one down, although they pursued it the greater part of a day, using relays of fresh ponies on the Loita Plains.

Wildebeests are usually found in herds of several score individuals, mostly cows and calves, with young animals, and one or more herd bulls; the latter are apt to fight desperately with one another on the slightest provocation, and if there is one acknowledged master bull in the herd he will occasionally make a dash after one of the others and drive it off at full speed. Often there are outlying sentinels in the neighborhood of a herd. Old bulls go singly or in small parties, either by themselves or in a mixed herd with hartebeests, zebras, and gazelles. When fighting the bulls frequently drop on their knees and plunge together, head on, with a resounding crash. The herds feed at all hours—wildebeests are exclusively grazers—but during the hottest part of the day are apt to lie down, when at a little distance they look exactly like American bison at rest on the prairies in the old days. Doubtless they also come to drink at all hours; however, we personally never knew them to go to the water at night, but only in the morning or afternoon;

they are more watchful and wary than other game, and probably dislike approaching a pool after nightfall for fear of the lion. If hartebeests or zebras are with wildebeests as they approach water, the former generally lead, the wildebeests hanging back. We have seen this again and again, and but once did we see the wildebeests of a mixed herd take the lead in approaching a pool. Mr. Abel Chapman, in "On Safari," has given an amusing and interesting description of the way that a herd of wildebeests will sometimes wait about until a hartebeest turns up as leader to take it to water. As is true of all game, wildebeest are much less apt to detect a foe lying in wait for them in the path they are following than to detect one endeavoring to approach them. If the direction in which a herd is travelling can be ascertained, a stunted, well-nigh leafless bush will serve as ambush sufficient for any one who crouches absolutely motionless in its shade. It is motion that catches the eye of game, and, moreover, any color loses much of whatever conspicuousness it possesses if broken light and shade fall on it. Time and again we have thus crouched beside or behind a bush and watched files of zebra and hartebeest and parties of wildebeest and gazelles and waterbuck canter by within less than a hundred yards—often not a score of yards away. They never noticed us.

Usually wildebeest are very local in their habits, the same herd keeping within a radius of three or four miles. At one camp where we spent a week or so we always found one herd of wildebeests kept within a couple of miles of a boldly shaped hill; and three or four miles off a single bull lived by himself, occasionally joining a party of gazelles and hartebeests but never coming near his own kinsfolk.

When water grows scarce the herd may have to trek to it a dozen miles each day, and if drought dries up the pasturage then all the wildebeests of a locality may have to shift their ground. Under such conditions the shift may be only for a few miles, or the animals may gather together to the number of several thousand and travel to far-off pastures in a great herd, like a herd of our own bison thirty odd years ago. There must be some kind of telepathy which thus influences all the animals of a given district to travel off in a certain direction, only to halt when they have reached some place which perhaps none of their kind have visited since years before the oldest among them were born. Lemmings and South African springbucks make such treks; the bison occasionally did; and occasionally wildebeest make, or made, such treks in addition to their ordinary shifts. The migrations of East African game, both seasonal and irregular, have as yet only been imperfectly worked out. There are some places in which the game spend the whole year and others where the game either shift their ground annually or at irregular intervals.

As one approaches a herd of wildebeest they stand and gaze, sometimes snorting or grunting, their heads held high and their manes giving them a leonine look. The bulls may pace up and down, pawing the ground and lashing their tails. Then, as the hunter comes nearer, down go their heads, and off they start, rollicking, plunging, and bucking before they settle into a hard, level gallop. Suddenly they all pull up short and wheel to look back; or while the herd is still cantering in a curve a couple of bulls or old cows will start at full speed in the opposite direction, curvetting and prancing as they pass their companions in re-

verse order. Then the whole herd may gallop in a curve, strung out in line or in a mass, some of the individuals going through queer gymnastics, kicking and flourishing their long tails; or a bull will almost stand on its head to toss up the dust with its horns; or two bulls may relieve their feelings by dropping on their knees for a moment's furious fight, clouds of dust floating above them as they thus curve and zigzag. Finally they conclude to leave the neighborhood; then they stop their ferocious and whimsical capering, and, their heads down, away they tear with beautiful, strong action.

They are very wary, and keep well out of rifle range, but they are also very curious and hang about, just out of shot, watching the hunter. In the same fashion they watch the lion, going fairly close to him, as they evidently feel confident that he cannot catch them unless so close that they cannot get under way before he is on them. Once we came across an old bull wildebeest watching a lion and lioness from a distance of about sixty yards; it was in the afternoon, and the lions obviously desired the bull for supper; but, although very much on the alert, he was not in the least disturbed by their proximity, and evidently knew as well as they did that at that distance they could not hope to catch him. Some observers have suggested that the game know when the lion is hungry and do not fear him except at such moments, and that this accounts for the small heed they pay to him if they see him on the plains in the daytime. We doubt this theory. Our impression is that they are altogether too accustomed to the lion to get panic-struck about him unless he rushes at them from ambush. They know that they can outrun him, and

if they see him walking or trotting over the plain they know he is not hunting them and they feel no uneasiness about him. In Africa there is no hour of the day or night when the game is safe from its enemies; each hunted creature is always in possible deadly peril, and therefore each grows accustomed to the peril, and pays no heed whatever to it unless it is at that moment imminent. A lion passing over the plain is no more to them than a shark passing under a vessel's stern is to a sailor aboard her. A wildebeest, zebra, or hartebeest gives itself no more concern over such a lion than the sailor gives himself over the shark, and for the same reason—because there is no danger.

These same observers, by the way, speak of the plains game as inert and stupid compared to bush game. This, also, is not in accord with our observations. The wildebeest is as alert, wary, and intelligent as any game of the woods or bush; and animals that are found both in the forest and on the open plain, as the waterbuck, do not differ, as far as we can see, in wariness and intelligence from those that dwell only on the plains. We have sometimes found waterbuck more wary than hartebeest, and sometimes less; but in only a very few instances have we ever found individuals of either species as wary as wildebeest. However, it is always necessary to keep in mind not only that animals of the same species show wide individual differences and wide differences according to locality, but also that the same individuals show astonishing differences in conduct at different times. We have found hartebeests and gazelles very wild in the morning and yet in the afternoon well-nigh heedless of us even when we

were to windward; and we have seen a flock of the usually tame Tommy gazelles run off in alarm, while a solitary wildebeest bull, which was with them and was usually far more shy than they were, displayed no emotion whatever about our presence.

We came across many carcasses of wildebeests that had been killed by lions, and we never saw any more signs of a struggle than with zebra or hartebeest. Doubtless they are sometimes killed near water, but all those whose bodies we saw had been killed in the open plain during the night. Evidently the lion had either stalked them or had lain motionless until, as they grazed or walked toward new feeding-grounds, they approached him. In one or two cases the marks showed that the lion had struck the claws of one paw into the wildebeest's head to hold him, a favorite trick of the lion with heavy or formidable game. In some cases the wildebeest had been seized on a flat, bare plain without a vestige of cover, the grass being cropped short. It was extraordinary that even in darkness so wary a beast should let so big a foe approach to within a few yards. Probably in such cases it was the wildebeest itself that approached, the lion's sinuous length being moulded along the ground, in the darkness, until the munching, grass-cropping herd walked slowly within reach of his tremendous rush—for a lion's furious dash, whether on prey or foe, is much more apt to be a rush than a spring. Doubtless in the lion's hunting at night—his regular hunting time—smell counts for much more than sight in guiding him to his prey; details like the prey's color are of no consequence whatever; his eyes are required chiefly to guide him in the actual grapple.

KEY TO THE RACES OF *albojubatus*

Legs lighter, drab or tawny-olive; horns more horizontal in direction, not curved down below level of orbit; body size larger *albojubatus*

Legs darker, olive-brown or sepia; horns curved downward well below level of orbit; body size smaller *mearnsi*

ATHI WHITE-BEARDED WILDEBEEST

Gorgon albojubatus albojubatus

NATIVE NAME: Swahili, *nyumbu*.

Connochætes taurinus albojubatus Thomas, 1892, Ann. & Mag. Nat. Hist. (6), IX, p. 388.

RANGE.—From the Athi Plains and south bank of the Tana River near the Ithanga Hills, in British East Africa southward throughout the highlands of the coast drainage to Kilimanjaro, and thence through the Rift Valley to central German East Africa.

A head of the white-bearded wildebeest shot by Jackson on the Athi Plains furnished Thomas, in 1892, with the material for his original description of this race. Notwithstanding that the white throat mane of this form is a really conspicuous difference from the black mane of the brindled wildebeest, it was for many years supposed to be indistinguishable from that species. Speke and Grant, in 1863, met with it on the Kigani River, opposite Zanzibar Island, and brought back with them two heads which were assigned by Sclater to the brindled widebeest. Later Fischer, Hildebrandt, Abbott, Jackson, Willoughby, and many others shot specimens in the vicinity of Kilimanjaro under the supposition that they were true brindled wildebeest. In 1905 Neumann described, from a specimen now living in the Berlin Zoological Garden which came from the southern slope of Kilimanjaro, another race which he named *hecki*. This he distinguishes from the white-bearded by the light grayish-brown forehead and lighter body color. Such color differences, however, are peculiar to the female sex and to immature animals and are of no racial significance. Sportsmen have thought that they detected two quite different

species of wildebeest in East Africa associating together in the same herds. One of these has been assigned to the typical brindled wildebeest with a black throat mane, and the other has been known as the white-bearded wildebeest. In the "Book of Antelopes" these two forms are considered and their ranges and characteristics stated. How this error has crept into the literature it is difficult to conceive, for no specimens representing a black-maned form have ever been collected in the region. The series of twenty-two specimens in the National Museum from British East Africa shows no variation from a wholly white or light-colored throat mane. In the southern portion of German East Africa specimens of the brindled wildebeest may occur. The southern limits of the white-bearded are not known. As no specimens showing intermediate coloration in the throat mane have been reported, we are not yet justified in considering the white-bearded a race of the brindled.

The Athi white-bearded wildebeest may be distinguished from the Loita race by the lighter-colored legs, the more horizontally directed horns, and the larger body size. The legs are drab in color, like the body, and never as dark as the olive-brown of the Loita race, and the body color is less blackish, the chest, shoulders, and lower sides never assuming a deep seal-brown or blackish cast. The horns extend in a horizontal plane from the head and curve downward comparatively little from their bases. Adult male specimens vary but little in body size and exceed but slightly the females. The flesh measurements of a male from the Kapiti Plains, shot by Colonel Roosevelt, were: head and body, 77 inches; tail, 24 inches; hind foot, 17 inches; ear, 8 inches. The skull of this specimen has a length of $19\frac{3}{16}$ inches. An average female skull measures $18\frac{1}{2}$ inches in length. The horns of adult males average 25 inches in greatest spread and about 20 inches in length, but the record head exceeds these dimensions by some 4 inches.

Loita White-Bearded Wildebeest

Gorgon albojubatus mearnsi

Native Name: Masai, *olengat*.

Gorgon albojubatus mearnsi Heller, 1913, Smith. Misc. Coll., vol. 61, No. 17, p. 1.

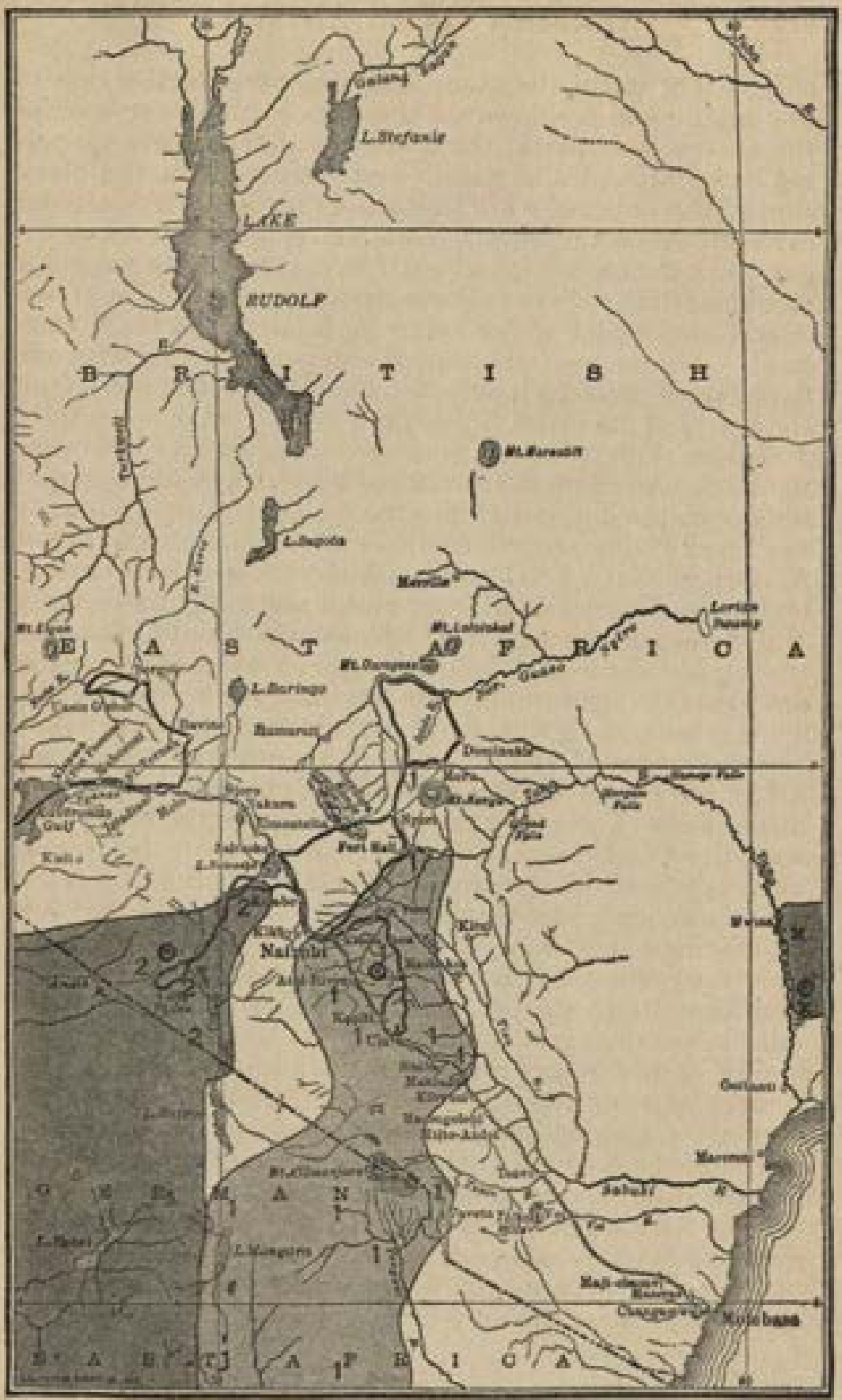
RANGE.—From the Loita Plains and Rift Valley in the vicinity of Mount Suswa southward to German East Africa and westward through the headwaters of the Victoria Nyanza drainage to Speke Gulf.

Wildebeest from the Loita Plains of British East Africa secured by the Smithsonian African Expedition under the direction of Colonel Roosevelt have clearly demonstrated the racial distinctness of the form occupying the extreme southwestern corner of British East Africa. A specimen shot by Doctor E. A. Mearns near the ford on the Southern Guaso Nyiro River has been selected for the type of the race which now bears his name. The Loita Plains white-bearded wildebeest differs from the form inhabiting the Athi Plains by the decidedly darker color of their legs, which are olive-brown or sepia in the old males and somewhat lighter in the females. The body color shows a tendency to become darker or quite blackish on the chest, shoulders, and sides. The horn differences consist in the more downward curve of the horns from the base, the lower margin falling well below the orbit and quite on a level with the condyles at the back of the skull. The skulls average smaller, indicating smaller body size.

The dorsal color is drab-gray, spotted and banded by dark patches due to the tips of the hair becoming dark-brown as though representing an old, worn pelage, the new only being drab-gray. This faded condition of the hair is not seasonal but is a chronic condition in the wildebeest, and has given rise to the color pattern and to the name brindled commonly applied to it. The limbs are darker than the body and are uniform olive-brown deepening somewhat on the pasterns. The chest, fore part of belly, and lower sides are clove-brown, and much darker than the back; the chest medially is black. The groins, axillæ, and inside of the legs are drab-gray like the back. The tail is like the back in color and furnished along the lower surface and at the tip with long black hair forming a terminal tuft fully as long as the tail itself. The neck is like the back, in ground-color but shows ragged cross-bands of dark hair bases. A mane of long black hair extends the whole length of the nape and is continued down the back by a black line to the rump. The throat is marked by a mane of long buffy or whitish hair from the chin to the

chest. The top of the snout from the interorbital region to the muzzle and far down on the sides to the lower level of the eyes is deep-black, the blackness at the muzzle spreading down around the mouth and uniting with the black chin. The upper lips are whitish at the tip of the snout and clove-brown on the sides. The sides of the head are drab-gray, like the neck, with a lighter streak bordering the black face blaze from the eye to the angle of the mouth. The crown is seal-brown and shows some contrast to the black forehead. The back of the ears is black and united with the dark-brown patch by a narrow ridge of color, but the rest of the base and the inside is pale drab-gray. Some males show a definite walnut-brown band across the forehead between the eyes, while others are marked by short, white chevrons similar to the specimen collected by R. J. Cuninghame on the Loita Plains and referred to by Lydekker in his "Game Animals of Africa." The female differs in color from the male by having the crown and interorbital region lighter-bistre or drab-brown in contrast to the black snout and lacking the black color on the chest, shoulders, and lower sides which are drab-gray, in conformity with the back. The legs are also lighter, being, as a rule, little darker than the drab body. The throat mane is shorter and more scanty than in the male. All of these color differences are also shared by the immature males. The newly born young, before the horns have started to bud, are much lighter-colored than the female. The body is at this age uniform vinaceous-buff with whitish or cream-buff under-parts and legs. The mid-dorsal line of the nape and back is marked by a short black mane from the occiput to the rump. The whole top of the head from the ears to the tip of the snout and well down on the sides below the eyes is quite uniform blackish or deep seal-brown, in this respect resembling the adult male. The chin is black as in the adult. The sides of the head, throat, and neck are vinaceous-buff like the body. The ears are wholly black on the back and whitish on the inside. The tail is like the body in color and only black at the tip.

The flesh measurements of this race agree closely with those of typical *albojubatus*, although the skull averages ½ inch less in greatest length. The horns average 22 inches in greatest spread which is somewhat less than those


L. Stefanie
LAKE
RUDOLF
B R I T I S H
E A S T A F R I C A
Mt. Kenya
Nairobi
Port Hall
Kisumu
Mombasa
Kisii
Kericho
Eldoret
Nakuru
Naivasha
L. Baringo
L. Magadi
L. Natron
L. Manyara
Tanganyika
Zanzibar
Dar es Salaam
Tanga
Moshi
Arusha
Lindi
Mikindani
Kilwa
Mafia
Pemba
Zanzibar
Kisumu
Kericho
Eldoret
Nakuru
Naivasha
Nairobi
Mombasa
Tanga
Moshi
Arusha
Lindi
Mikindani
Kilwa
Mafia
Pemba
Zanzibar
Dar es Salaam
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L. Manyara
L. Natron
L. Magadi
L. Baringo
Mt. Kenya
Port Hall
Kisii
Kericho
Eldoret
Nakuru
Naivasha
Nairobi
Kisumu

of Athi specimens. The largest pair in the series of 11 males has a width of 24¼ inches and a length of 21. A series of 15 specimens from the Loita Plains have been examined in the National Museum which represent localities in the Southern Guaso Nyiro drainage and the headwaters of the Amala River near the German boundary.

Hartebeests

Bubalis

Bubalis Lichtenstein, 1814, Mag. Nat. Fre., Berl., p. 154; type *B. buselaphus*, the bubal hartebeest of Algeria.

The hartebeests form a very distinct genus. They are easily recognized by their elongate heads, which have a peculiarly straight dorsal profile owing to the great projection backward of the horn bases or pedicle beyond the condyles of the skull. No other group has such a union of the horn bases into a pronounced pedicle from the ends of which the horns fork. The hartebeest has extremely high withers and a narrow body. The tail is moderately long and tufted. The ears are narrow but of fair length. The horns are alike in the sexes and are usually curved at sharp angles outward and then backward or inward. They are of moderate length, usually equalling the head. The female is much smaller in body size than the male, being usually a third less in weight. The calves are lighter-colored than their parents, being a uniform buffy-fulvous. The skull is without definite anteorbital fossa, having merely a shallow depression in front of the orbit. The horn pedicle is very long and forks posteriorly to the condyles, and is in breadth less than the length from the fork to the orbit. The nasal bones are very long and extend forward as far as the tip of the snout. The mammæ are reduced to two. The genus includes six or seven well-marked species with their geographical forms. Although the various species show considerable distinction, their ranges nowhere overlap, and as a genus much discontinuous distribution occurs. The fossil species described are a Pliocene species from India and two Pleistocene species from the Transvaal, one of which, *B. priscus*, had horns very similar to *cokei* but was a somewhat larger animal.

The genus is confined to Africa, where it ranges from Algeria and the Abyssinian highlands south to the Cape but is absent from the Congo forest area. Arabia has been credited with a hartebeest but without any satisfactory evidence. The error, however, has gotten well established in zoological literature and is based on the statement of Canon Tristam concerning the occurrence of the bubal hartebeest in Eastern Syria in the vicinity of the Dead Sea from rumors received from the Arabs inhabiting that district.

We encountered swarms of Coke hartebeest in eastern and middle East Africa and swarms of the far bigger and handsomer Jackson hartebeest west of them, while on the border line between these were here and there colonies of the closely allied Nakuru hartebeest. In Uganda and along both banks of the White Nile we found hartebeest akin to the Jackson. The Swahili name for every kind of hartebeest is kongoni. The exact relationship and geographical distribution of these species and subspecies are discussed in the technical part of the work. The habits of all the species are substantially the same; that is, the individuals of one species in one locality differ more in habits from the individuals of the same species in a totally different kind of locality than from the individuals of another species in an exactly similar locality. We therefore discuss them under one head. Indeed, even in aspect the chief difference that strikes the observer is one of size; the Coke hartebeest weighs on an average from three hundred to three hundred and fifty pounds, while the Jackson, a far finer beast in every way, is more than half as long again, reaching a weight of five hundred pounds and over. There are marked horn differences in addition, however.

Hartebeests, where not exterminated by man, range

over most of the continent of Africa, outside of the mountains, the heavy forest, and the true desert. In individual abundance they unquestionably surpass any other of the genera of big game with the doubtful exception of the gazelles, if these can be called big game; their range is greater and they are more plentiful within it. Taken as a whole, in the parts of Africa we traversed, hartebeests were at least three or four times as numerous as any other horned animal. We saw no zebra in Uganda or along the Nile; in East Africa they were more abundant than any of the buck except the hartebeests, but the latter outnumbered them about three to one. There were no hartebeests on the Northern Guaso Nyiro, where we found both kinds of zebra, their ranges here overlapping. Why the hartebeests were not found in this region we cannot guess. It is an illustration of the queer and seemingly causeless and capricious discontinuous distribution of so many African game animals. The ordinary zebra, the bonte-quagga, in its various color forms is almost always found in company with one or another kind of hartebeest; the hartebeests extend over vast areas to which zebras do not penetrate; but at this point the zebra flourishes where the hartebeests are not found. In like fashion the big Grévy zebra is found at different points of its range—north, south, and west—in company with various forms of hartebeests, but they are wanting in other places. In East Africa the small gazelle, the Thomson, so abundant farther south, also fails to reach the Northern Guaso Nyiro; yet a form of its big congener, the Grant gazelle, elsewhere found in company with it, is common along that river. The distribution of the small gazelle is limited to the highlands and it does not occur below an alti-

KONGONI COKE HARTEBEEST
Shot by Theodore Roosevelt, Athi Plains
Group mounted by J. L. Clark in the United States National Museum, Washington, D. C.

KONGONI COKE HARTEBEEST, FEMALE
From Nairobi, B. E. A.
Presented to the National Zoological Park, Washington, D. C., by W. N. McMillan

KONGONI FROM THE ATHI PLAINS OF BRITISH EAST AFRICA

tude of three thousand feet, but the Grant gazelle occurs much lower and occupies the low desert tracts. Altitude is apparently the cause which prevents them from occupying the Uasin Gishu Plateau lying at a height of seven to nine thousand feet, which is above the ranges of both gazelles. The topi is abundant in certain tracts and entirely absent from big intervening tracts seemingly in no way different. Such discontinuous distribution reaches its height in the case of the square-mouthed rhinoceros.

The hartebeest is never found in the dense tropical forests, whether of mountain or lowland. By preference it haunts the treeless, or well-nigh treeless, open plains; but according to our experience it also goes, rather more freely than the zebra, into the sparse open woods of small, scantily leaved thorn-trees; and both in Uganda and along the 'Nzoia we now and then found it in fairly thick vegetation, among trees, bushes, and tall grass. It cannot too often be said, however, that in these matters equally trustworthy observers disagree, chiefly because animals of the same species differ widely in their habits under different conditions of time and place. Captain Stigand, for instance, says of these East and Middle African hartebeests that they "practically are never seen in bush or in shade; they seem even to mistrust the proximity of bush." As a general proposition this is unquestionably true, for the hartebeest, like the wildebeest, topi, *zebra*, and gazelle, is pre-eminently an animal of the bare, open plain; but according to our experience Captain Stigand's statement is far too broad. We have frequently come on hartebeests among thorn-trees or in shade, and sometimes in country where it was impossible for them to avoid the neighborhood of thick bush. It is

merely a case of difference of observation, doubtless both accurate. As regards wildebeest, our experience was identical with Captain Stigand's, who says that they inhabit open plains exclusively and are never seen in bush country; but the French hunter M. Vasse particularly mentions that in Portuguese East Africa, although they live in the vast, bare plains they spend the hot hours in the small thorn woods—a habit we never observed in East Africa, where the wildebeest herds never left the plains, lying in them during the hot hours. Along or near the edges of these bare plains hartebeest may be found grazing in company with waterbuck and impalla; if alarmed the latter will make for the timber, and the kongoni for the open; but we have occasionally found each species spending hours in the haunts of the other. In the Lado the waterbuck, kob, and hartebeest were ordinarily found in precisely the same localities and often associating together.

Normally, however, the hartebeest is found on the bare plains, associating intimately with the other plains-dwellers mentioned above. Its habits are so nearly identical with those of the zebra that the two animals habitually mix in the same herd. Where both species are numerous, such mixed herds are almost as common as herds composed exclusively of only one or the other species. Wildebeest and gazelle may be found in the same herd with either zebra or hartebeest. Sometimes such a mixed herd will consist of numbers of every species—say a score of zebra, as many hartebeest, and a dozen wildebeest—sometimes a single individual of one kind will go with a herd of another kind, a wildebeest with zebra, a hartebeest with a wildebeest herd, a beautiful Grant gazelle with a mass of zebra, wildebeest,

and hartebeest; or, a rather comical sight, a shaggy and ferocious-looking wildebeest bull may dwell with a band of diminutive and delicate-looking "Tommy" gazelle. We have seen topi and hartebeest together in big herds, just as I have seen the common zebra in herds with eland, oryx, and its big relative the Grévy zebra.

These plains game are very gregarious; and although single individuals, usually battered old males, are not uncommon, the mass of them feel uncomfortable if alone. A herd is harder to stalk than a single individual. Evidently each animal feels a sense of companionship and guardianship when with others, even though of a different species. But of course the companionship between herds of two different species is always intermittent, even although habitual. They may graze together toward water, or even lie down together; but after a time they are almost certain to separate, whether while grazing or when frightened. Nevertheless, occasionally animals of different species, usually friendless outcasts, but not always so, will become permanent companions.

Hartebeest may be found in herds of a hundred individuals or over or in parties of but half a dozen. Like all other game of the bare plains, they make no effort to escape observation, their one aim being to keep so sharp a lookout that they may themselves see their foes while at a distance. This is much more easy for them than for the forest-dwellers; and because of this fact, and because of the abundance of food for the grazers, as distinguished from the browsers of the woodland, the dwellers on the bare grass-land are usually far more numerous, area for area, than the dwellers in the great forests—and this is true in Africa as in America.

The bison and the barren-ground caribou were always far more plentiful than the moose, just as the hartebeest and zebra are far more abundant than the bongo. Unquestionably the plains-dwellers in the absence of man can hold their own better against brute foes, and thrive better, than the forest-dwellers; and this continues to be true in the presence of scattered savages in a low stage of development; but the conditions are reversed as soon as industrial man appears, especially when he is a rifle-bearer, and then the plains-dwellers vanish from the land long before the beasts of the dense woodland have grown scarce.

In many parts of East Africa the grass is so good and the water so plentiful that the hartebeest stay permanently in one neighborhood all the year round, and, moreover, each herd or group in that neighborhood may have a special beat not more than a couple of miles or so in diameter. Ordinarily the local range is somewhat larger, but not much, for when circumstances are favorable it is astonishing to see how limited the home range of such an animal is. If there are seasonal droughts, however, the hartebeest may all, or nearly all, shift in a body to new pasturage; but when we were there there did not seem to be such common and marked migrations among them as among the wildebeest and oryx. If the land is very dry and the pasturage poor the size of the home range and the likelihood of wandering for each herd or individual are greatly increased. In very dry wastes the wandering may be continuous.

It is much easier to watch and study the habits of the game of the bare plains than those of forest or bush country. At many of our longer camps we grew to know various

individuals and herds of the common plains game, and we sometimes got a fair idea of the ordinary round of their lives. It is a simple enough round, as a rule, and yet there are extraordinary, indeed inexplicable, variations in it under certain conditions. By far the most extraordinary of these is one which concerns not merely hartebeest, but many other African animals, including especially giraffes, eland, and oryx; namely, the power among certain animals of all these species, in certain localities, apparently to go not merely for days but for weeks without drinking. In certain districts of East Africa we found the hartebeest herds drinking at irregular intervals, but at least twice every twenty-four hours; sometimes in the morning or afternoon, that is, in broad sunlight, and sometimes at night. In other places they drank but once, and in one or two places, as well as we could tell, only about every other day. But there are regions in Africa where it seems certain that hartebeest never drink at all for weeks at a time, the herds being found where there is absolutely not a drop of surface water. This we have never, personally, seen; but on the Northern Guaso Nyiro we watched herds of reticulated giraffe which, we are reasonably certain, did not drink for several days, perhaps a week, at a time. Their companions, the oryx and the big gazelle, were drinking regularly. Of course, it is possible in this case that the giraffe were at this time drinking at some water of which none of the few natives knew, but we do not believe it. At any rate, both in the Kalahari Desert and in Somaliland, as well as in certain other tracts, there are seasons of the year in which various animals—giraffe, oryx, eland, hartebeest, gazelle—apparently exist without water for periods

so long as to seem incredible. In places, we suppose, they dig up bulbs and melons, for it seems impossible that such huge beasts, in the dry heat of that climate, can get on absolutely without water or plants containing moisture, as many smaller desert animals, such as jerboas, unquestionably do. At any rate, this is a matter of extraordinary interest, which should be studied on the ground by competent naturalists.

The swarming hartebeest of different species which we studied, the herds, mixed and unmixed, the families, the solitary bulls, lived under conditions which offered no such enigmas to the inquirer; they were where they could always get water; they were stationary, for we never even came on them migrating. They lived on or near the equator, and the seasonal changes were evidently not sufficient to give them any one breeding-time. In different places we found calves of different ages; and in other places, notably on the Kapiti and Athi Plains, where the animals were extraordinarily abundant, we found calves of all ages, so that evidently there was no fixed time for the rut or for breeding. Often we found large herds of bulls, cows, and calves; often we found small parties of cows with but a single bull, and other small parties of bulls, or single bulls, which had evidently been unable to appropriate any cows. The bulls waged fierce battles among themselves. Like the wildebeest bulls, they often fell on their knees opposite each other before springing together, butting and stabbing with their short horns. Their horns do not seem as formidable as those of many other antelopes; but the only case we actually came across in which any antelope was killed in one of these duels was that of a

hartebeest. Evidently his opponent had stabbed him in the chest, hooking him with an upward motion as they faced each other, and, when he turned, had ripped open his flank. Rather curiously, the only injury actually inflicted on any man or horse of the Buffalo Jones party, in roping lion, boar, rhinoceros, giraffe, zebra, eland, and other antelope, was by a hartebeest; after it was roped the cowboys were careless with it, thinking it harmless, and with a sudden rush it stabbed the horse of one of them. They doctored the wound and the horse recovered. These cowboys, by the way, rode down and roped the hartebeest in fair chase. This is not a feat to which ordinary African hunting-ponies are equal, but Buffalo Jones and his cowboys, Messrs. Means and Loveless, were mounted on the best type of Western American cow-horses, big, blooded beasts of great speed, courage, endurance, and sure-footedness. They could overtake any animal in Africa. In our experience we found the topi, hartebeest, and wildebeest (we did not chase the gazelles) the fleetest animals of the plains; on our horses we could not overtake them when they were in small parties or single, but when in herds they interfered with one another and we could get close enough for a shot. Hartebeest and topi were the fastest. They were very agile, too, and would bound easily over one another or over low ant-hills. Two or three of our horses could overtake zebra, and eland were not difficult to ride down. Once we crouched among some thin, low thorn-bushes and watched long files of zebra and hartebeest canter by within a few score yards; we were interested and surprised to see that the hartebeest frequently cantered with their mouths open, which we had

supposed was a proof of exhaustion, whereas they were all entirely fresh.

Often we saw a bull hartebeest practising for a fight, so to speak; he would get down on his knees on the bare plain, or against the side of one of the huge ant-hills, and butt and horn the ground, so that his face and horns and knees would be covered with earth. Sometimes a whole herd would stroll toward a bare bit of soil which they evidently used as a stamping-ground, and on reaching it would stamp and kick up the dust and roll in it; the spot might be level or it might be the side of an ant-hill. Such a place would be trodden into bare, pulverized dust by the sharp hoofs. Zebra also came to these places to roll. Generally the hartebeest scattered their droppings anywhere, like most other game; but several times we came on places —one such area was thirty feet across—in which many hartebeest had dropped their dung for quite a long period of time, evidently resorting thither for that purpose. The Grant gazelle sometimes showed the same habit, and it seemed to be usual with the little dikdik. The herds of hartebeest sometimes visit the salt or mineral licks like the other game; in such places we have seen acres of ground covered with gullies and hollows, licked out by the tongues of countless generations of wild creatures. Like most game, they are tormented by hosts of insects—biting flies, loathsome bot-flies, and ticks. The ticks swarm in unbelievable numbers on the Kapiti and Athi Plains; elsewhere they are only ordinary pests. They weaken and even kill horses; but, curiously enough, the game seem to thrive in spite of them. We have seen rhinos, wildebeest, zebra, and hartebeest with their groins, their armpits, the bare

spaces under the tails, the neighborhoods of the ears (and inside them), and spectacle-like rims around the eyes covered with thick masses of swollen ticks, like dark barnacles; yet the animals would be fat and in good condition. The biting flies and bot-flies annoy them much more. But they like to scratch their hides. We have seen hard, stubby trunks, and even corners of isolated rocks, worn to a polished smoothness by the myriads of game that for scores and perhaps hundreds of years had used them as rubbing-posts.

Hartebeest are grazers, not browsers. Like most other game, they draw sharp distinctions between different kinds of pasturage. Great areas of long, thick-growing grass will be left untouched, probably because it is sour pasturage, while adjoining areas with different grass will be grazed bare by innumerable wild herds. Hartebeest are rather silent animals; they utter a kind of gasp or sneeze as a note of curiosity, warning, or alarm. They are both wary and silly, and the same animals, under the same conditions, will at different times show, now the utmost wildness, now a foolish tameness. Their high withers and low quarters, and their long, homely heads, carried at right angles to the neck, and therefore almost upright, give them an awkward look; but when at speed their even, regular, powerful action changes their whole look. If pursued by a single dog, for which they care little, they will play in front of him, bounding and buck-jumping. One of their marked habits is to stand on ant-hills, especially if they have the slightest suspicion of threatened danger. When herds are grazing or resting, whether lying down or standing up, single animals will often be seen

standing motionless and alert on a neighboring ant-hill. Such animals are often spoken of as sentinels, as deliberately performing, and set to perform, sentinel duty for the herd. Much study of the herds left us in doubt as to whether this was or was not the case; as to whether there was more in the habit than the individual suspiciousness and wariness of an animal concerned only with his safety and not thinking about his companions at all. Often we saw herds where there were one or more individuals on the lookout, which therefore in effect acted as sentinels; but more often the herds were grazing, resting, or lying down without any sentinels. Moreover, if the seeming sentinel lay down or began grazing there was normally no attention paid by the rest of the herd and no attempt made to supply its place by another sentinel. Yet once, when the possible sentinel descended from his post on an ant-hill, we certainly saw another take his place; but this one may merely have been rendered uneasy by his companion's movements and have risen to look round on his own account; for when, after half an hour's motionless watching, the beast became satisfied, descended and began to graze, no other animal took his place or paid heed to what had happened. When startled or puzzled the lookout animal might give the kind of sneeze spoken of above. With both hartebeest and wildebeest we have seen single individuals watching, on the grazing-grounds and at the watering-places, under circumstances that made it seem as if they were deliberately acting as sentinels for the herd; but we never were sure that this was the case or that the animal was behaving otherwise than it would have behaved if entirely alone. Indeed, we are inclined to think that the

herd is protected purely by the spontaneous individual vigilance of its members, each exercising the vigilance on its own account and for its own safety; but of course fuller observation may show that this is not the case, and that different animals do take up in succession the function of sentinels for the guardianship of their fellows.

As we have already said, there are the widest differences of conduct among individuals of all the species of game, and this is true, among other things, of their wariness, both as between all the individuals of one locality and all those of another, as among individuals of the same locality, and as between an individual at one time and at another, even on the same day. We have passed by herds of game which let us come within easy range of them, although they were to leeward of us, without moving; and on another day, or even on the same day, have had them flee in panic and terror at sight of us a quarter of a mile off, or on getting the wind of us at a like distance. In most of the portions of Africa through which we hunted, the beasts of prey exacted a much heavier toll of life from the game than did the white hunters; and they were in far greater and more continuous dread of the lion than of the rifle-bearer. In other words, in most places the game lived under substantially natural conditions; there were only a few species which had materially diminished in numbers over a considerable area because of the incoming of the white man or which, because of his presence, had materially changed their habits. The hartebeest and zebra, for instance, were just as they always had been. They as often from folly blundered into the power of the lion, as into the power of the hunter. In the daytime they often showed the same curious disre-

gard of both lion and hunter and, trusting in their speed and agility—they knew that the lion, unlike the human hunter, was not dangerous at any distance—we have seen a wildebeest staring unmoved at a lion and lioness at a distance of sixty yards, although they obviously had designs on him, and we saw a party of hartebeest galloping along not far from, and paying no heed to, a lion we were pursuing. But they were always on the watch, for even in daytime the lion, leopard, cheetah, and hunting hound sometimes assailed them, and at night they were, and knew that they were, ever in danger, and were subject to continual panics; one of the stock grievances of the settlers is that in their continual wild stampedes at night the zebra and hartebeest are always galloping through the wire fences. Speaking generally, and having in view the numerous qualifications above dwelt on, the wildebeest were the shyest, and the little Tommy gazelles the tamest, of the common plains game. The hartebeest were less shy than the wildebeest, and when a mixed herd came to water the hartebeest usually came first. We have seen a single hartebeest lead a herd of wildebeest, whereas if the mixed herd was composed of hartebeest and zebra either might lead. A herd of unmixed wildebeest was generally much shyer and more wary, both when grazing or resting and when going to water, than a herd of hartebeest or zebra.

In several different places we were able to study hartebeest herds for some days at a time and get an accurate idea of the routine of their daily lives. The striking facts are, first, the simplicity and monotony of their lives, even when in danger, and second, the amount of time spent in eating.

Certainly three-fourths or four-fifths of the whole time was spent in grazing or chewing the cud. Most of the remaining time the animals were sleeping, either lying down or standing up. There were no stated times for sleeping or resting and grazing. Usually during the heat of the day the herds would lie down, sometimes half the individuals lying down and the others standing up; or they might stand or lie under the thin half-shade of almost leafless, wizened little thorn-trees. One or two, or more, might be keeping a lookout. Yet more than once we have seen herds feeding at high noon, especially if the day was overcast. On one occasion a herd we had watched grazing all the afternoon, and which we expected to see then go to water, deliberately lay down toward nightfall, and were still lying down when it grew too dark to see them. Probably after feeding and moving around for a few hours the herd rests or lies down, whether by night or day. Hartebeests may come to water in the night-time, or at dawn or in the late evening, or in the sunlight of the forenoon or afternoon. Ordinarily a typical herd consists of bulls, cows, and calves of all ages. The bulls may fight among themselves; the cow about to calve may go off alone to drop her calf, and not rejoin the herd for a few days; and a bull wishing to work off its rutting rage in a safe fashion will plough along on its knees or almost stand on its head and dig the bare earth with its horns. There are continual false alarms, and at the moment of attack by a beast of prey the panic and terror of the stampeding creatures reduce them to madness. But these emotions are as short-lived as they are violent, and soon the run becomes a canter; the herd gathers and begins to graze without further thought of the one that has been

slain. Sometimes, although not often, they blunder down wind to a drinking-pool with reedy margin; but if they have reason to suspect that their chief enemy, the lion, may be in the neighborhood, they are very alert, travel to and fro, and make many halts, and often break back at a run, as they venture near the water.

KEY TO THE SPECIES OF *Bubalis*

Horns wide-spread and bracket-shaped, turning at right angles to the horn pedicle; horn pedicle short; body size smaller *cokei*

Horns narrowly V-shaped and diverging gradually from their base; horn pedicle very long, extending far behind condyles of skull; body size larger *lelwel*

COKE HARTEBEEST
Bubalis cokei

The Coke hartebeest is easily recognized by its wide-spread, bracket-shaped horns and light-buffy or tawny coloration. It is a considerably smaller species than lelwel and has a much shorter head with very differently shaped horns. In fact, the two species stand at opposite ends of the hartebeest evolutionary tree, *cokei*, with its short head and wide-spread horns, being one of the least specialized of the genus. The horns in the Coke hartebeest project backward, in line with the profile of the top of the head, but spread out sharply laterally at right angles and then turn backward again, the points usually extending parallel from the last turn. The Coke hartebeest occupies the territory east of the Nile watershed from central German East Africa northward to the Tana River and Lake Baringo. An isolated race is found in the northeast drainage area of Lake Rudolf on the Abyssinian border. Four geographical races are recognizable by difference in horn shape, but show no marked color distinctions.

KEY TO RACES OF *cokei*

Horns broadly bracket-shaped and turned sharply outward at right angles

Dorsal coloration darker or more tawny-rufous; body size and horns smaller *cokei*

Dorsal coloration lighter or more buffy; body size and horns larger *kongoni*

Horns without a sharp right-angle turn outward, bowed out regularly

Horns wide-spread but not angulated or bracket-shaped; coloration darker and more tawny *neumanni*

Horns narrower or more V-shaped in direction; coloration lighter and more buffy *nakuræ*

COAST HARTEBEEST

Bubalis cokei cokei

NATIVE NAMES: Swahili, *kongoni;* Taita, *nose.*

Alcelaphus cokei Günther, 1884, *Ann. & Mag. Nat. Hist.*, XIV, p. 426; fig. of horns.

RANGE.—Coast district of British East Africa from the Tana River southward to Kilimanjaro and central German East Africa, west as far as the eastern edge of the highland plateau; absent from the moist coast belt.

The typical race was described by Doctor Günther in 1884 from a head shot by Colonel Coke in Usagara, German East Africa, in 1880. This was the first complete specimen of this very abundant species to reach Europe. Von der Decken had previously, in 1862, collected the horns near Kilimanjaro. Speke and Grant must have met with this hartebeest, but their accounts are so vague that they may refer to the Lichtenstein hartebeest rather than this species.

The typical Coke hartebeest is a smaller and more reddish animal than the highland race named *kongoni.* It is indistinguishable in horn shape from the latter, but the skull is decidedly smaller, averaging an inch less in length. The dorsal color is usually darker or more reddish, especially the crown and the snout, which are cinnamon-rufous

or hazel. In central German East Africa, south of the Pangani River, the Coke hartebeest meets the range of the very distinct Lichtenstein hartebeest, but the two species are not known to be associated together in the same localities.

Flesh measurements of specimens are not available. The largest male specimen collected by Doctor Abbott at Taveta measured 17⅝ inches in skull length, 16¼ inches in length of horns on the outside curve, and 13 inches in spread at the tips. The individual variation, however, is great, both in horn shape and in size of skull or body size, so that the recognition of the race must be based on average differences. On the plains at the base of Kilimanjaro they are very abundant, but in the low deserts of Taru and Taita they are far from common. Hunter has reported them as far north as the Tana River.

Kongoni Hartebeest

Bubalis cokei kongoni

Native Names: Swahili, *kongoni;* Kikuyu, *ngonde;* Masai, *olsorikor.*
Bubalis cokei kongoni Heller, 1912, Smith. Misc. Coll., vol. 60, No. 8, p. 5.

Range.—Highlands of British East Africa from the slopes of Mount Kenia and Lake Naivasha southward and westward to the southern shores of the Victoria Nyanza and northwestern German East Africa.

The hartebeest inhabiting the Loita Plains district of British East Africa was described as a new race under the name *kongoni* in 1912 from a specimen shot by Colonel Roosevelt. Sportsmen have generally considered the hartebeest of the highlands as indistinguishable from *cokei* of the coast lowlands owing to the great individual variation in horn shape and size of head in this group of antelopes. The *kongoni*, however, is decidedly a larger animal with lighter dorsal coloration. The coloration is more purely buffy, with very little of the reddish suffusion except on the crown and snout, which is tawny, very seldom being as dark as the cinnamon-rufous of the typical *cokei.*

The dorsal coloration is uniform tawny-ochraceous, becoming on the lower sides, the rump, and hind quarters

somewhat lighter, clear buff in color, giving the rump an indefinite lighter coloration. The forelegs in front are tawny-ochraceous, like the body, but behind and on the inside they are buff. The hind legs are buff, with the exception of a darker stripe in front from the hocks to the hoofs, which is tawny-ochraceous. The clefts of the hoofs in front are often bordered by blackish hair. The basal one-half of the tail is short-haired and buff, like the rump, the terminal half being black-haired and tufted. The breast and belly are buffy, like the rump, but the groins and axillæ are quite whitish. The crown of the head and the snout are tawny and distinctly darker than the back. The sides of the head and throat are buffy-ochraceous, from which the chin is set off by its black or dark seal-brown color. The ears are ochraceous on the back and white on the inside and at the base.

A male specimen from the Loita Plains measured in the flesh, in length of head and body, 72 inches; length of tail, 22 inches; hind foot, 20½ inches; ear, 8 inches. Females are somewhat smaller than these dimensions, an average specimen measuring 67 inches in length of head and body; tail, 16 inches; hind foot, 19 inches; ear, 7¾ inches. Skulls from the Loita Plains average in length 17¾ inches in males. The largest specimen in a series of fifty from British East Africa measures 18½ inches. The horns vary greatly in length and spread. The longest male horns in the large series in the National Museum are 17¾ inches long, the widest being 17⅝ inches at the tips. Ward records a large number of specimens from British East Africa exceeding these dimensions. His record in length is 21 inches and in spread 19 inches. These dimensions, however, represent freak or abnormal specimens. Average specimens measure 16 inches in length by 14 inches in spread. As usual, among antelopes, the record horns all belong to young adult animals in which the points have not yet been worn down. The master herd bulls usually have the horns very much worn at the tips and greatly shortened. The horns of the females are much more slender than those of the males and are shorter.

A large series, some seventy specimens, have been examined in the National Museum. This material shows

great individual variation in horns and skull size, but scarcely none in coloration. The specimens from the Athi Plains or the region east of Nairobi are more or less intermediate between typical *kongoni* of the Loita Plains and *cokei* of the Kilimanjaro region in size of skull. They average considerably less than Loita Plains specimens, although the extremes of the two series are quite equal in dimensions.

Nakuru Hartebeest

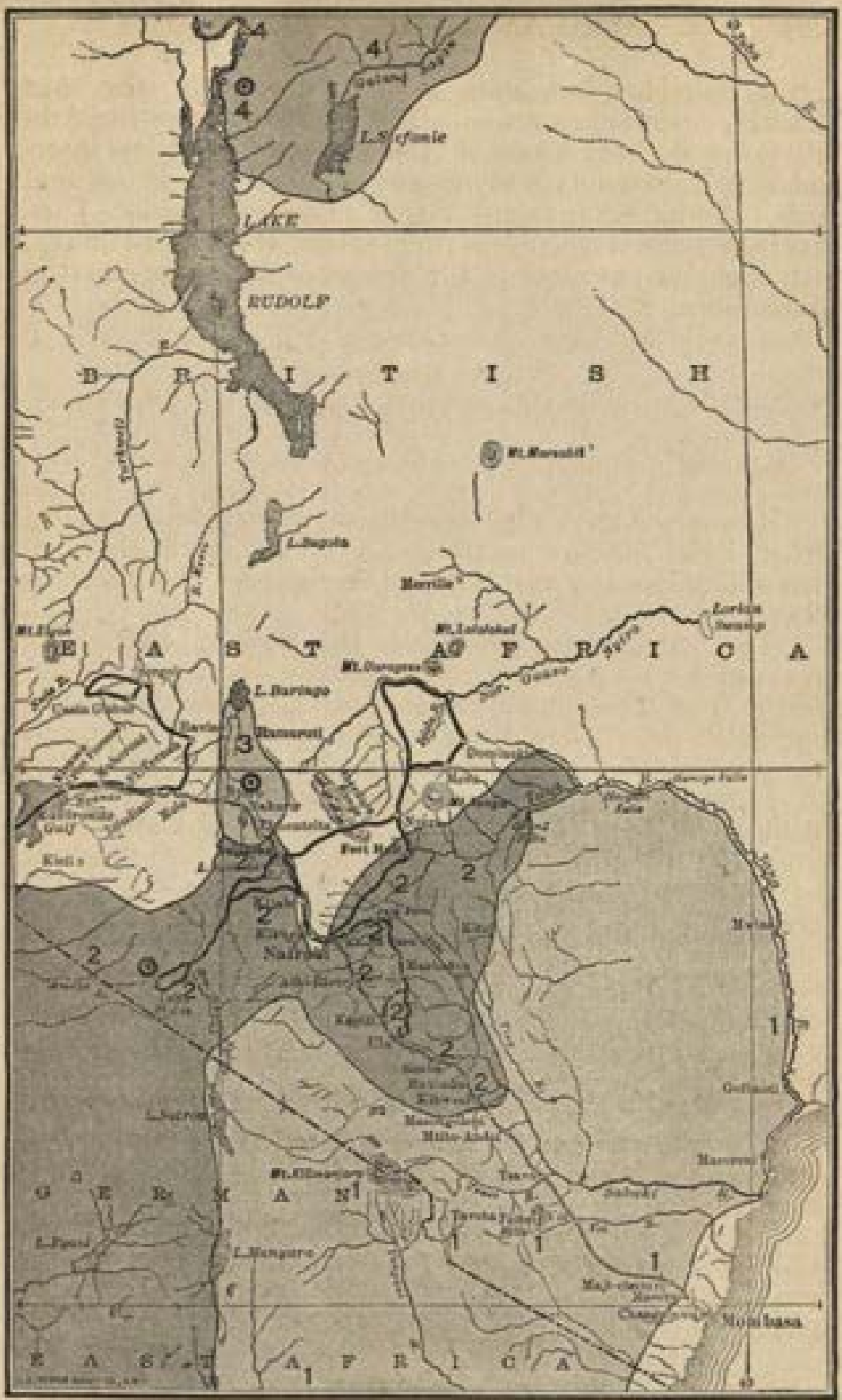
Bubalis cokei nakuræ

Bubalis nakuræ Heller, 1912, Smith. Misc. Coll., vol. 60, No. 8, p. 6.

Range.—Rift Valley of British East Africa ranging from Lake Nakuru northward to the south shore of Lake Baringo and eastward to the base of the Aberdare Range.

The hartebeests inhabiting the district near Lake Nakuru have long been recognized by sportsmen as different from the common kongoni owing to their less widespread horns. They have usually been referred to as hybrids between the kongoni and the Jackson hartebeest or as representing the Neumann hartebeest described by Rothschild from Lake Rudolf. Their recognition as hybrids is not consistent with what is known regarding the habits of the species concerned or, for that matter, of the breeding habits of mammals generally. Hybrids among mammals are of very rare occurrence and are produced only under very unusual or abnormal circumstances, and never in great numbers, at certain points in the ranges of distinct species. The kongoni and Jackson hartebeests are nowhere known to be associated together in the same herd, although their ranges in the Rift Valley are contiguous. The Nakuru hartebeest resembles closely in characters the kongoni and is as widely separated from the Jackson hartebeest as is that form.

The Nakuru hartebeest is a geographical race of the Coke hartebeest occupying the northwest corner of the range of the species. It is most closely allied to the kongoni, which it resembles closely in size of body and color-



MAP 9—DISTRIBUTION OF THE RACES OF THE COKE HARTEBEEST

1 *Bubalis cokei cokei* 2 *Bubalis cokei kongoni* 3 *Bubalis cokei nakuru*
4 *Bubalis cokei neumanni*

ation, but may be distinguished by its less widely spread horns, which lack the angular bracket shape of that species. In horn shape it approaches closely the Neumann hartebeest of Lake Rudolf, from which if differs by lighter coloration and narrower horns. In the large series of specimens of *kongoni* from the Loita Plains, in the National Museum, are one or two which closely approximate *nakuræ* in horn shape, and these are connected by intermediate specimens with the normal bracket-shaped horns of the typical race.

No flesh measurements are available for comparison. Three specimens shot near Lake Nakuru by Kermit Roosevelt represent the race in the National Museum. One of these has been selected as the type of the race. Two other specimens from Lake Baringo have been examined in the British Museum. The larger of the two males shot by Kermit Roosevelt has a skull length of 18¼ inches and horns of the same length, but with only 8 inches spread at the tips. The narrowness at the tips is due to the inward curvature, the horns being widest about the middle of their length. Herds of hartebeest have been seen on several occasions on the Naivasha Plains, flanking the Aberdare Range on the west, which doubtless belong to this race, as they have from this point northward a continuous range to Lake Baringo.

Neumann Hartebeest

Bubalis cokei neumanni

Bubalis neumanni Rothschild, 1897, *Ann. & Mag. Nat. Hist.*, vol. XX, p. 376.

Range.—From the northeast shore of Lake Rudolf and the east bank of the Omo River eastward to Lake Stefanie and its tributary streams.

A. H. Neumann, while elephant hunting at the extreme north end of Lake Rudolf near the village of Bumi, shot the type specimen of the hartebeest which Rothschild named for him in 1897. Neumann saw them only at this particular locality. A few years later Donaldson Smith met with this hartebeest, which he refers to as Coke's, north of Lake Stefanie and again on the east bank of the Omo

River, but states that on crossing the river no more were seen, their place being taken by the *lelwel*. The Neumann hartebeest is widely separated geographically from the British East African races of the Coke, which it closely resembles. Geographically it is much more intimately connected with the tora hartebeest, to which its horns have considerable resemblance.

The Neumann hartebeest is known only by the specimens collected by Neumann on the shores of Lake Rudolf. The type is in Rothschild's Museum at Tring, and another, a female specimen, is in the British Museum. These specimens have been examined. They differ from the Nakuru hartebeest by their more wide-spread horns and darker dorsal coloration, but their differences are remarkably slight considering the widely isolated character of their habitat. The horn measurements of the two known specimens are: male, length, 16½ inches; spread at tips, 8⅛ inches; female, length, 13½ inches; spread at tips, 9⅞ inches.

Lelwel Hartebeest

Bubalis lelwel

The lelwel represents the extreme type of hartebeest development in length of head and narrowness of horn spread. The horn pedicle in this species attains its greatest development and projects far behind the condyles of the skull. In body size the lelwel exceeds the other species. The species represent the maximum in grotesqueness and size, compared with the others of the genus. The coloration is quite uniform and reddish in tint, although there is in some of the races an approach to the black legs and face blaze and dorsal stripe of the Caama hartebeest of South Africa. This latter species, although widely isolated geographically, is a closely related species in horn and skull shape. The lelwel is primarily a Nilotic species which has spread eastward in British East Africa, where it is now contending in the Rift Valley with the Coke hartebeest for territory.

KEY TO THE RACES OF *lelwel*

Black stripe on front of legs
  Black dorsal stripe or face markings wanting — *lelwel*

  A black dorsal stripe on nape and withers; head with a black blaze or black cheek patches — *insignis*

Black markings on legs or body wanting
  Horns narrow, with long pedicle
    Dorsal color darker, cinnamon-rufous; head shorter — *jacksoni*

    Dorsal color lighter, ochraceous-tawny, head longer — *roosevelti*

  Horns wider-spread, with shorter pedicle — *keniæ*

HEUGLIN LELWEL HARTEBEEST

Bubalis lelwel lelwel

NATIVE NAMES: Djeng, *lelwel;* Monbuttu, *nakibbee;* Niam-niam, *songaroh.*
Acronotus lelwel Heuglin, 1877, Reise, N. Ost. Afr., II, p. 124, fig. horns.

RANGE.—West side of the Nile from the Bahr-el-Ghazal drainage area south to the Albert Nyanza.

Von Heuglin met with this hartebeest during his explorations of the upper Nile in 1863–4. He described it in 1877, giving it the name by which it is known to the Djeng tribe of the Bahr-el-Ghazal district. He published with his description a figure of the horns, which he compared to the closely allied Caama of South Africa. A few years later Schweinfurth met with the same species on the headwaters of the Bahr-el-Ghazal drainage and records its occurrence, together with a list of its native names. The lelwel has remained in obscurity for many years, but recently it has been re-established by Lydekker.

The Heuglin lelwel is distinguishable from the Roosevelt lelwel of the east side of the Nile by the presence of black stripes on the front of the legs and by its somewhat smaller size and slightly lighter color. A series of five specimens shot by Colonel Roosevelt in the Lado Enclave near Rhino Camp are in the National Museum. The flesh

JACKSON LELWEL HARTEBEEST, MALE
Uasin Gishu Plateau, B. E. A.

ROOSEVELT LELWEL HARTEBEEST, MALE
Gondokoro, Uganda

EAST AFRICAN AND NILE RACES OF THE LELWEL HARTEBEEST

measurements of the longest-horned male in this series were: length of head and body, 76 inches; tail, 26 inches; hind foot, 22 inches; ear, 7½ inches. The horns are 20¼ inches along the curve and 8⅝ inches in spread at the tips. The longest-skulled male in this series measures 20¾ inches in greatest length, which is considerably less than the longest from the east side of the Nile, but exceeds that of any specimen of *jacksoni* or *insignis*.

Roosevelt Lelwel Hartebeest

Bubalis lelwel roosevelti

Native Name: Bari, *loba*.
Bubalis lelwel roosevelti Heller, 1912, Smith. Misc. Coll., vol. 60, No. 8, p. 7.

Range.—The lowlands bordering the east side of the Nile from the Albert Nyanza northward to the Sobat drainage.

A specimen shot in the vicinity of Nimule on the east side of the Nile by Colonel Roosevelt has been selected as the type of this race. It is a large race, the length of skull exceeding that of any other lelwel. It may be distinguished from the typical lelwel by the absence of black on the legs and from *jacksoni* by its decidedly larger size and lighter coloration. From *niedecki* of the upper Sobat drainage, which also lacks the black leg stripes, it is distinguishable by its lighter color, distinctly larger size, and by its longer horn pedicle.

The dorsal coloration is a uniform ochraceous-tawny which fades gradually into ochraceous-buff on the rump, hind quarters, legs, and under-parts. The front of the legs, however, are a bright tawny, which deepens on the front of the pasterns and the clefts of the hoofs to a brownish-black. The tail is furnished with a long tuft of black hair at the tip. The head is uniform in color with the exception of the chin, which is deep seal-brown in color.

A male shot by Heller at Gondokoro measured in the flesh 75 inches in length; tail, 24 inches; hind foot, 21 inches; ear, 7¾ inches. The longest pair of horns are those of an immature male from the same locality measuring 24½ inches in length with a spread at the tips of 12

inches. This is the longest pair of horns of any lelwel in the National Museum and falls but one inch short of Ward's record from the Nile. The horns of the older or fully adult males are all shorter, owing to the wearing down of the points. This race will no doubt be found to carry the longest horns of any lelwel in conformity with its larger body size. The longest-skulled specimen from Gondokoro measures 21⅞ inches, exceeding by more than an inch that of any other race in the large series in the National Museum.

Uganda Lelwel Hartebeest

Bubalis lelwel insignis

Native Names: Baganda, *enangazi;* Unyoro, *enas.*
Bubalis jacksoni insignis Thomas, 1904, Proc. Zool. Soc., p. 455.

Range.—From the hill country of Karagwe in German East Africa northward over the plateau region of Uganda as far as the highlands east of Nimule.

We also owe to Jackson's efforts the discovery of this hartebeest. It was named by Thomas in 1904 from a specimen secured near the Maanja River, in central Uganda. It is one of the rarest and least known of hartebeests owing to the extremely local character of its distribution. It has been reported from Buddu by Gedge, from Karagwe by Scott-Eliot and from the Mount Agora region of northern Uganda by Powell-Cotton, but only the latter of these records is represented by museum specimens.

The Uganda lelwel is characterized by having more extensive black markings than any other race. Besides having the black leg-bands it has a black dorsal stripe on the nape and back and also a black face blaze or black cheek patches. The dorsal stripe and the black face markings are sometimes absent or only faintly indicated. In the general body color and size it is identical with the Jackson hartebeest.

Four specimens were collected by the Roosevelt expedition in the Maanja River drainage near the village of Kisingo. The flesh measurements of one of these specimens, a male, were: head and body, 73 inches; tail, 21 inches; hind foot, 21¼ inches; ear, 7¾ inches. The skull

MAP 10—DISTRIBUTION OF THE RACES OF THE LELWEL HARTEBEEST

1 *Bubalis lelwel lelwel* 2 *Bubalis lelwel roosevelti* 3 *Bubalis lelwel niediecki*
4 *Bubalis lelwel insignis* 5 *Bubalis lelwel jacksoni* 6 *Bubalis lelwel kenie*

of this specimen measures 20 inches in length, the horns 21½ inches in length with a spread of 9½ inches at the tips.

Jackson Lelwel Hartebeest

Bubalis lelwel jacksoni

Native Names: Nandi, *chemnyokoso;* Turkana, *etulia.*
Bubalis jacksoni Thomas, 1892, *Ann. & Mag. Nat. Hist.*, p. 386.

Range.—Plateau region of Mount Elgon and the Mau Escarpment from the Lumbwa country northward beyond the headwaters of the Turkwell River.

Jackson discovered the hartebeest which now bears his name on his initial journey to Uganda in 1889. Until very recently the name was applied broadly by sportsmen to all the hartebeests of the lelwel type found in Uganda and the Nile Valley. The Jackson hartebeest, however, is a distinct race occupying the highland region of the Mau and Mount Elgon. It is a darker and richer red than any other race and somewhat smaller in size than the Nile races. The color is quite uniform cinnamon-rufous without any black markings on the legs or face. The only contrasts in its coloration are the black chin and terminal tuft of the tail and the white hair lining the inner side of the ears.

A large series of specimens is in the National Musuem, from the Uasin Gishu Plateau, collected by the Roosevelt expedition. The flesh measurements of one of the adult male specimens were: head and body, 72 inches; tail, 23½ inches; hind foot, 23¼ inches; ear, 8¼ inches. An average male skull measures in length 20 inches, that of a female 18½ inches. The horn length averages about 22 inches. Great variation in the spread at the tips is shown in the series, which ranges from 4 to 14 inches in this measurement. Such variation is due to the wide diversity in direction taken by the horns near their tips. As a rule, however, the points extend parallel after making the final turn backward at right angles to the dorsal plane of the head. Ward's record horn length for this race is 26 inches. The longest specimen in the National Museum series is 23½ inches in length.

Kenia Lelwel Hartebeest

Bubalis lelwel keniæ

Bubalis lelwel keniæ Heller, 1913, Smith. Misc. Coll., vol. 61, No. 17, p. 3.

Range.—From the plateau region north of Kenia westward across the Laikipia Plateau to Lake Baringo.

The Kenia lelwel was very recently described from a specimen shot by Paul J. Rainey on the plateau region north of Kenia some twenty miles northeast of the station of Nyeri. The hartebeest inhabiting the north Kenia Plateau is distinguishable from *jacksoni* by decidedly widerspread horns, shorter horn pedicle, and by somewhat lighter coloration. From the Coke hartebeest, which it resembles in shade of coloration, it is at once distinguishable by its V-shaped horns, longer head, and larger body size. This race is confined to the plateau region flanking Mount Kenia on the north and drained by the Northern Guaso Nyiro River. It represents the extreme western range of the lelwel type of hartebeest. A. H. Neumann, in his "Elephant Hunting in East Africa," mentions shooting this type of hartebeest on the southwestern slopes of the Lorogi Mountains. This locality, no doubt, represents the northern limit of the range. Westward it connects with typical *jacksoni* in the region west of Lake Baringo. It occurs in very limited numbers, is exceedingly wary, and is seldom secured by sportsmen.

The type, which is an adult male, measured in the flesh, in length of head and body along the curve of the back, 78 inches; tail, 22½ inches; hind foot, 21¼ inches; ear, 7¼ inches. The skull has a length of 19½ inches. The horn pedicle has a least width of three-fourths its length from the orbit to the forking of the horns and is much wider than in other races of lelwel, in which the width is only two-thirds the length. The dimensions of the horns in this specimen are 21¼ inches in length by 10¼ inches in spread at the tips. Besides the type there is a younger male from the same district, also collected by the Rainey expedition. This specimen is very much lighter in color but agrees with the type in the size and shape of its horns and horn pedicle.

CHAPTER XIV

BUFFALOES

Subfamily *Bovinæ*

The subfamily *Bovinæ*, comprising the oxen, bison, buffaloes, and their allies, are the largest or most heavily built members of the family *Bovidæ*. They are characterized by their heavy bodies, short, thick legs and neck, and large heads. The muzzle is large and broad, the snout of moderate length, and the face without anteorbital glands. The horns are broad or rounded but never ringed, and are well developed in both sexes. The female is furnished with four mammæ. The body varies in outline from the low withers and well-developed hind quarters of the ox and buffalo to the high withers and weak hind quarters of the bison. The tail is long and tufted, the hoofs large, with well-developed false hoofs, the pelage rather short and often scanty, and the coloration monocolor without contrasting color marks of any sort. The teeth are very much broader than those of antelopes, with rectangular crowns, and broad crests or lophs with the valleys between very shallow or obsolete. The skull is without sinuses between the facial bones, but has rather long nasal bones, small anterior nares, and broad expanded tips to the premaxillary bones. The horn-cores arise laterally behind the orbits and extend outward and downward or backward but never upward at an angle to the dorsal profile of the head. In general shape the skull resembles closely that of the

brindled wildebeest, which is without doubt a near relative of the group.

The subfamily ranges through temperate North America; Europe, from Great Britain, within historic times, eastward to Asia and the Malay Islands, and Africa south of the Sahara. Members of the group have been found only as far back as the Pliocene, but were at that time quite as widely distributed as at present. Notwithstanding the absence of the *Bovinæ* in the older Tertiary geologic formations, they are not a modern group but rather one whose ancestral forms are still unknown.

African Buffaloes

Syncerus

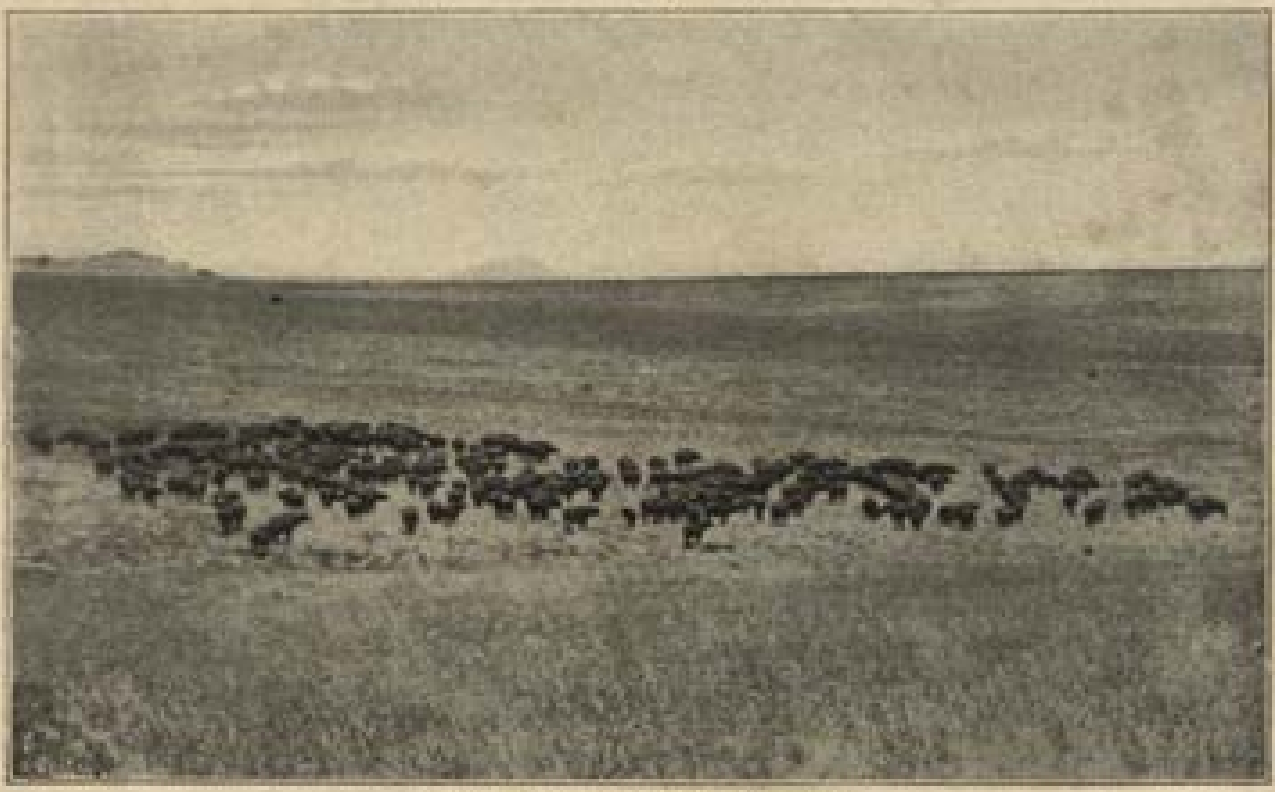
Syncerus Hodgson, 1847, Journ. Asiatic Soc., Bengal, XVI, new series No. 7, p. 709; type fixed by Hollister, 1911, *Bos brachyceros*, the Lake Chad buffalo.

A considerable number of distinct generic names are to-day employed for the African buffalo by various writers. Some of the names used do not apply, while others are too comprehensive to be applicable to our present conception of genera. The old Linnæan genus *Bos* is of the latter category. It is often used in a broad sense by writers for all of the *Bovinæ*, but should be limited as a generic term to the ox and its close allies. *Bubalus*, another name frequently used in a generic sense for the African buffalo, is properly applicable to the Indian buffalo, as the latter shows differences in the skull and shape of the horns from the African which are of generic weight. The name is also objectionable on account of its close similarity to *Bubalis*, the generic designation of the hartebeests. Those who consider the African buffalo a distinct generic type from the ox and the Indian buffalo must employ the term *Syncerus*, of Hodgson, who proposed it in 1847 for the African buffalo inhabiting the Lake Chad or Bornu district. The generic character of greatest weight in this genus is the lack of attachment of the vomer to the palatine bones.

Other characters are the massive horns, which are very broad basally and cover the whole crown of the head, the concave profile of the snout, the short, broad nasal bones, and the broad ears. The genus is confined to Africa south of the Sahara, where it is of universal distribution from the low coast lands to the limits of forests on the highest mountain areas. A single species, *caffer*, with its several geographical races, comprise the genus. Three fossil species, very recently extinct, from the Pleistocene age have been described. One of these from the Orange Free State, *baini*, had very much longer horns than the species now living in the same region, but closely resembled in this respect a species, *antiguus*, described from deposits of the same age in Algeria. A third species has been described from the Pleistocene of Natal.

Nearly a quarter of a century ago the African buffaloes were smitten by a terrible scourge, a cattle sickness of such virulent character that as it traversed the continent, from north of the equator to south of the Zambesi, it swept the herds from the face of the earth. Domestic cattle suffered equally, and a few of the big bovine antelopes suffered slightly. Of the buffaloes in East Africa and Uganda probably *not one in ten thousand was left alive!* It was an appalling calamity. The destruction was far more sudden than is ever the case when man is the sole agent, and far more complete for the length of time involved. But there was a vital distinction. When the disease had spent its force it vanished, and the scattered survivors were left free to recover the lost ground. The extraordinary vigor of natural reproductive power, of wild fecundity when there is a vacant place for its action, was then shown to the uttermost. The few remaining buffalo found themselves in precisely the position of the feral horses and cattle turned loose by the Spaniards on the grassy plains of America. They

EAST AFRICAN BUFFALO, MALE
Shot by Theodore Roosevelt at Kamiti Farm
Trophy at Sagamore Hill, Oyster Bay, New York



HERD OF EAST AFRICAN BUFFALO
Upper Tana River near Fort Hall, B. E. A.
From a photograph by Carl E. Akeley

EAST AFRICAN BUFFALO

had what was for their purposes a nearly vacant continent to conquer by dint of their reproductive power. Except where civilized man has been present, and in spite of the presence of the native foes of the buffalo, this reconquest has been largely achieved.

This fact shows that this animal, at least, can more than hold its own as far as its brute enemies are concerned, and, where the climatic conditions do not forbid, will populate to near the limit of its food supply. Buffaloes are now common beasts in East Africa and abundant in Uganda. The wise policy of the British Government in protecting all the big game has aided in this recovery.

The buffalo of the White Nile belongs to the Abyssinian species, or subspecies; while the East African buffalo is closely allied to the Cape animal. But there is no difference in habits between the two races, although within the limits of the same species there are marked differences between the behavior of the herds in one region and of the herds in another.

Buffaloes are grazers and are fond of water. They are not beasts of the desert, and, unlike the giraffe, eland, and oryx, they cannot exist in nearly waterless regions. They are gregarious, going in herds of from a score to a couple of hundred individuals; and in addition old bulls are found singly or in small parties, while occasionally a herd will consist of nothing but cows, calves, and young stock. Buffaloes are hardy animals, and are found in varying and very different habitats within the limits of their general range. Neither the zebra nor any of the antelopes can adapt themselves to such varying conditions, provided only that there is no dearth of water. In places buffaloes live on or near the

open, grassy plains beloved of the zebra and hartebeest; elsewhere they live in dense forests; elsewhere they wander in the neighborhood of some river running through waterless flats of grass or thorn-trees; they are found in the high mountains, where the nights are very cold; and they are also found in the low-lying, hot regions near the coast.

In their daily habits buffaloes differ both according to the nature of the country and according to whether they have or have not been much hunted. In places where they live in dense forest and are hunted, they venture into the open only after nightfall; and where much molested they never feed by day, so that observers have treated them as purely nocturnal animals. But we are convinced that these exclusively nocturnal habits are not natural to them. Doubtless they everywhere graze as freely, or almost as freely, in moonlight as in sunlight; and probably the twenty-four hours are often divided into periods of alternate feeding and resting, without much regard to light or darkness. But in many places they feed and rest out in the open during the day, and in other places they spend the day in thorn jungle so thin as to afford but scanty cover.

We studied one herd on Heatley's farm, near the Nairobi falls. The buffaloes must have numbered over a hundred, and Heatley had carefully preserved them; he had killed one or two bulls, and his Boer farmer had shot another in his garden one night, but there had been so little molestation that the animals were living practically as if there were no men in the country. Sometimes the whole number of animals, or nearly the whole number, went in one big herd. More often one or two small herds split off from the main one, and there were also outlying bulls which went singly

or in small parties. Their home was in a great belt of papyrus swamp, fifteen miles long, or thereabout, and a mile broad in places. This papyrus belt was a regular morass of slime and water. The thick-growing papyrus stems, with their plumed heads, were twenty or thirty feet tall. The gloomy depths of the morass served as a secure refuge for the buffaloes, and they had trodden innumerable trails hither and thither through it. These trails were mere lanes of deep mire and water, with the huge stems of papyrus crisscrossing over them; only the vast strength of the beasts, their short, thick legs and brawny bodies, enabled them to plough their way along them, or at need to shoulder a passage through the reeds. If buffaloes were not half-amphibious beasts they could not dwell amid such surroundings. While the herd was among these huge reed beds it was practically safe from pursuit; that is, a keen hunter would have gone in after them as a matter of course if it had been impossible to get them otherwise, but the odds would have been much against the man's success, and the danger would have been serious; besides there was no difficulty in getting them outside the reeds. Their station when in the reed beds was usually marked by the attendant cow-herons. These small white herons accompany the elephant, rhino, and buffalo in flocks, frequently alighting on their backs. They catch the grasshoppers and other insects kicked up from the grass by the feet of their hosts. In Heatley's papyrus swamp the cow-herons evidently found the dark cover uncongenial. The flock, which accompanied the herd in the open as familiarly as cow-buntings accompany cattle in our own pastures, usually perched in a body among the papyrus tops when the herd was resting near by among

the bottom stems. It was a pretty sight, as the white plumage glistened in the sun, and it generally enabled us to know just where the herd was. There was no food for the buffaloes in the papyrus, and evidently they liked to rest in the open no less than to graze there. We saw them outside, on the grassy plains, even half a mile away from the papyrus, grazing or lying down, at every hour of the day. We found them grazing outside the reed beds for a couple of hours after sunrise and then retiring to their wet and gloomy fastness. We also saw them come out to graze in the early afternoon, and return to the swamp shortly before sunset. We also found them lying down in the open at about ten in the morning, and up and grazing almost at high noon. There was evidently no invariable routine; and of course these buffalo could get water at any time they wished.

On the banks of the Northern Guaso Nyiro we found that the buffaloes came down to the river to drink every night. Evidently they thought the strip of thick tree jungle alongside the river too narrow to harbor them, and by dawn they were well on their way back to the dry flats and sparse, parched thorn jungle which covered the country away from the river. When we were there the withered thorn-trees gave almost no shade; and while the buffaloes rested, standing or lying, the sun shone pitilessly on the black bodies. Following the trails from the river, we generally found the animals resting; but we found one herd feeding quite late in the forenoon and another feeding at almost noon. The scent of the buffalo is as keen as that of the elephant or rhino, and its sight far better, so that it is much more difficult to stalk. We never saw anything in the nature of a sentinel; the

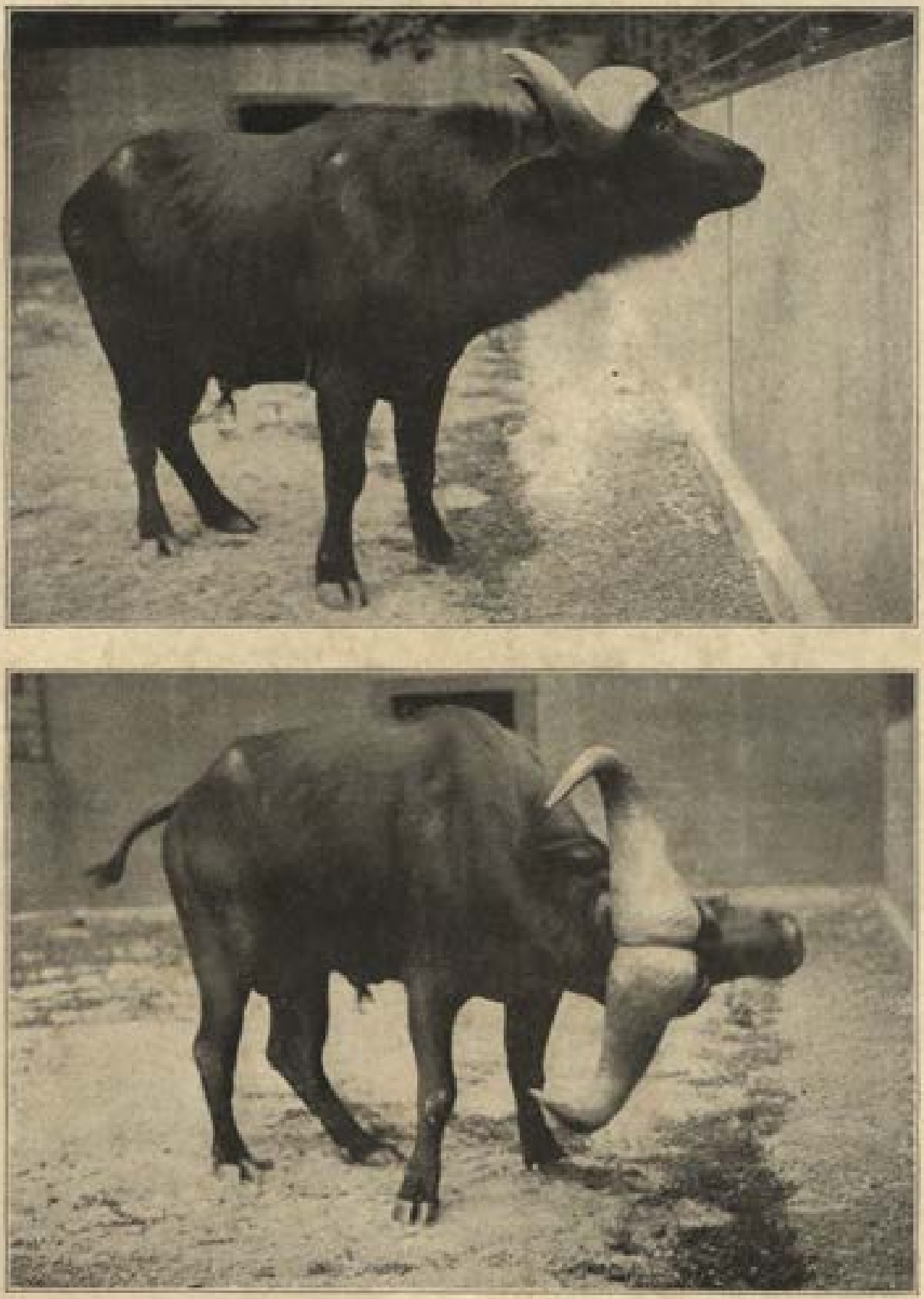
herd trusted to the vigilance and the sharp senses of its members, individually and collectively.

The Abyssinian buffaloes we encountered were in the Lado, on the western bank of the Nile. They were living in country much like that along the Northern Guaso Nyiro, and their habits were substantially those of their Northern Guaso Nyiro cousins. At one camp by a native village, we found a herd living in the dense reed beds, through which they had trampled a tangle of trails. This herd entirely realized that they were safe in their reed fastnesses, and only came into the open country at night to graze. Yet in the same neighborhood there were other buffaloes with entirely different habits. These lived among the dry, scattered thorn-trees, which, interspersed with a few other trees such as palms, covered the surrounding country, but nowhere formed thick cover. There were a few pools at which these buffaloes drank. They fed and rested alternately throughout the day and night. We found a bull grazing at midday. They rested, standing or lying down, among the nearly leafless thorn-trees, which gave scant shelter from the sun.

Aside from man, the buffalo's one enemy is the lion. Of course, a crocodile may occasionally take one, or a calf or yearling may be killed by wild hounds, but the lion is the only beast that ever follows the buffalo as an ordinary prey. There are localities where lions prey on buffaloes almost solely, just as in some other places they prey almost exclusively on domestic cattle. But where we were the lions habitually preyed on other game and rarely attacked either buffaloes or cattle. In the Lado they killed pigs and antelopes; in East Africa, zebras and antelopes. A buffalo is a

tough and dangerous beast, and where zebra and hartebeest abound lions naturally follow the easier quarry. On Heatley's farm a family of lions made their day lair in the big papyrus belt which also harbored the buffalo herd. Usually neither interfered with the other, the lion finding ample hunting among the swarming buck of the surrounding plains; yet one night two lions killed a buffalo heifer just outside the papyrus. A single lion, no matter how large, will rarely, unless very hungry, tackle an unwounded buffalo bull; when one is killed by lions it is usually by a party of them, and the assailants do not always escape scathless, it being no uncommon thing for one of them to be killed or wounded in such a fight. A big lion will kill a buffalo cow or young bull without much difficulty. This is because the lion makes his assault by surprise, and at the outset gets such an effective hold that the doomed buffalo has no chance to exert its enormous strength. A cow with a young calf is so on the alert that she is apt to detect the approach of her foe; and if she does so she herself makes the assault, without any hesitation, and may kill or drive off the lion.

The buffalo is rightly deemed one of the most dangerous beasts of the chase to be found in the world. In unfrequented places, or where it has grown accustomed to domineer over defenceless natives, it will attack unprovoked. Near Kenia, while we were there, a cow buffalo regularly ran amuck through the villages, killing and crippling a number of persons before the young men slew her with spears. Shortly after we left Africa, Messrs. McMillan and Selous made a trip down the Northern Guaso Nyiro, and one of their porters was charged and mortally hurt by a buffalo. On Heatley's



EAST AFRICAN BUFFALO, MALE, AGE SIX YEARS
From Central German East Africa
In the National Zoological Park, Washington, D. C.

LIVING SPECIMEN OF THE EAST AFRICAN BUFFALO

farm passers-by had twice been charged, unprovoked, by old bulls. But the real danger comes when wounded buffaloes are followed, especially into thick cover.

Nowadays, in Africa, buffalo have to be killed on foot, by tracking, or by still-hunting through the country in which they are found. Their heavy bodies and sharp hoofs make it comparatively easy for a good tracker to follow them, and although their senses are keen they are easier to stalk than antelope, being easier to see and just as easy to approach when seen. They are everywhere less easy to kill than rhinos. They do not travel such distances as elephants, and hence their chase does not necessitate such wearing fatigue. The actual circumstances of the stalk vary completely with the cover and the local habits of the animals. Beasts that only venture from the forest or thick jungle at night are, of course, very hard to follow successfully. In light, open jungle, or where the beasts feed on the plains near cover in daylight, it is not difficult to bag a buffalo.

Usually there is little danger in the first shot if taken from a reasonable distance, although even under such circumstances there is now and then a determined charge. Following a wounded buffalo is proverbially risky, as we have already said. Veteran hunters differ widely in their estimate as to which beast is the most dangerous; the claims of lion, leopard, elephant, buffalo, and rhinoceros have each been stoutly defended. Our own belief, based on all the evidence, is that when a buffalo bull does turn to bay it is to the full as formidable as—and probably more formidable than—a lion, and much more formidable than an elephant, but that it turns to bay far less freely than either. Our own slight experience supported this view,

although it was too slight to offer much basis for judgment by itself. Our party killed about a score of lions, a dozen buffaloes, a dozen elephants, a score of rhinos, and half a dozen leopards. The leopards were the pluckiest and most savage of the lot, although, because of their small size, less formidable to life than the other game. It happened that no buffalo charged us, whereas several lions charged with great determination, and two or three of the elephants charged without being molested. Most of the difference was undoubtedly due to chance or individual variation. Yet we cannot believe that lions would have failed to charge if placed as some of the buffaloes were, although the latter did not charge. The first buffaloes we attacked were four bulls grazing outside a papyrus swamp. On our firing at them they ran, not into the swamp, but into the open. At two or three hundred yards they halted. One then fell dead; two others had been wounded. Yet on our walking toward them as they stood facing us—black, ugly, formidable-looking—they lost heart and again ran. All four were killed without charging. Under similar circumstances it is hard to believe that a lion would not have charged; again and again we saw lions turn to bay and charge on less provocation.

KEY TO THE RACES OF *caffer*

Horns curving downward from the base well below the level of the floor of the skull; horns long and massive, greatest spread 40 inches or more; basal palm of horn very wide
radcliffei

Horns only curving down from the base to the level of the floor of the skull; horns shorter and narrower across the base, greatest spread considerably less than 40 inches; width of palm at base less than 10 inches
æquinoctialis

East African Buffalo

Syncerus caffer radcliffei

Native Names: Swahili, *mbogo* or *nyati;* Masai, *olaro;* Kavirondo (Jaluo), *jui.*

Bubalis caffer radcliffei Thomas, 1904, Proc. Zool. Soc., p. 371.

Range.—From the Northern Guaso Nyiro River drainage and the northern highlands of Uganda southward through British and German East Africa; east as far as the coast, and westward to the Edward Nyanza and Lake Kivu.

The buffalo has been known to occur in East Africa from the dawn of its history. During the early exploration of the country it occurred in countless thousands from the bush country of the coast to the plateaux of the far interior, and was much better known than it has been since its partial extermination by the rinderpest in 1890. Speke and Grant recorded the buffalo as abundant everywhere throughout the grass country. In 1904 Thomas described the East African buffalo as a distinct race from the South African, applying to it the name *radcliffei*, and basing his description upon a specimen collected in Ankole, Uganda, by Colonel Delme-Radcliffe during his boundary survey of the German border. Two years later Matschie published a paper describing several races from East Africa upon trivial differences in horn shape. The differences which Matschie has assigned to his races are of an individual character and of no racial value, and on this account cannot be recognized. At least seven of his racial or specific names, as he uses them, apply to the race here considered as *radcliffei.* The differences in horn shape in a single herd of buffaloes are really quite wide individually when animals of the same age alone are compared. The age difference is known by all sportsmen to be much greater, varying from the short, horizontally directed horns of the young bulls to the great, massive, downcurved horns of the old bulls. In "East African Game Trails" Colonel Roosevelt, having in mind Matschie's paper, mentions the extensive variation in horn shape he observed in a herd from which he shot several specimens at Kamiti Farm, and throws doubt upon such races as Matschie's, based upon slight differences in horn shape. Matschie re-

plied to this criticism by naming two more races from this very spot, representing the two extremes of horn shape to be found in the herd. He cheerfully agreed with Colonel Roosevelt that the horn variations he mentioned actually existed in this herd, but justified the naming of the two additional races under the assumption that two distinct forms met at this place and associated together. We, however, contend that the variations in structure shown by individual members of a race or species associated together or occupying the same territory must be taken as representing the individual variation in that form. It would indeed lead to great confusion in systematic zoology if the racial characters assigned by the describers were not to be subject to the test of individual variation as shown by geographically associated individuals. In fact, there is no other practical way of determining the individual variation of a race.

The East African buffalo differs from the typical race of South Africa by the smooth or flat character of the palm of the horn base and the larger average size of the horns in the bull. The horn bases in the South African races are rugose and roughened by ridges. There is, however, no difference in body size, in coloration, or in the condition of the hair covering between the equatorial race and the southern. Both sexes are uniformly black throughout their pelage, and the horns and hoofs are also blackish. The hair is coarse, of fair length, and usually so scanty that the dark-brownish color of the skin shows everywhere and adds largely to the color effect of the animal. The tail is furnished with a long tuft of black hair, as in domestic cattle, and the broad ears are margined by an irregular fringe of rather long hair. The nursing young are lighter than their parents, being a uniform dark-rufous color. The horns of the female are much smaller than those of the male and are quite different in shape, curving downward only as far as the level of the condyles of the skull.

The largest-bodied bull in the National Museum was shot by Colonel Roosevelt at Kamiti Farm. The flesh measurements of this specimen were: head and body along contour of back, 108 inches; tail, 35½ inches; hind foot, 25¼ inches; ear, 11¼ inches. The skull of this individual

measured 19¼ inches in basal length by 9⅛ inches in zygomatic breadth. It was, however, the smallest-horned individual of the three males shot in this herd, the horns having a maximum spread of only 40 inches, with a length along the inside curve of 27 inches. The largest-skulled specimen in the collection is one shot by Kermit Roosevelt on the Northern Guaso Nyiro, having a basal length of 20½ inches, with a zygomatic breadth of 9½ inches. The horns of a bull shot by Paul J. Rainey near the same river exceed in spread those of any other examined. The dimensions of this pair are: maximum spread, 44½ inches; length of horn on inside curve, 34 inches; width of palm, measured by calipers, straight and not over the curve, 8⅞ inches. The flesh measurements of an adult cow shot at Kamiti by Colonel Roosevelt are: head and body, 92 inches; tail, 28 inches; hind foot, 23½ inches; ear, 10¼ inches. Length of skull, 19 inches; zygomatic width, 8¾ inches. Horns: maximum spread, 36 inches; length on inside curve, 23 inches; width of palm, straight, 5¾ inches. The record buffalo of all Africa is a representative of this race and was obtained near the type locality in Ankole by District Commissioner Knowles. The horn dimensions of this specimen are: greatest spread, 52½ inches; length on inside curve, 48¾ inches; width of palm on curve of face, 11¾ inches.

The East African buffalo is found throughout all the well-watered parts of the country and as far northward in the desert as the streams or water will allow. The Tana River marks its northern boundary in the coast drainage. North of Mount Kenia the buffalo follows down the Northern Guaso Nyiro far into the desert, and occurs also north of the river in isolated herds on the forested summits of Mount Uaragess and the Mathew Range, reaching its northern desert limits on the peak of Mount Nyiro, at the south end of Lake Rudolf. From Mount Elgon the range extends northward on the high plateaux as far as the Mount Agora district, east of Nimule, at which latitude the adjacent lowlands are occupied by the Nile buffalo. Upon the slopes of Mount Kenia the buffalo ascends to the limits of the forest and occasionally strays over the tundra-like moorland of the alpine zone to the permanent snow-fields. A mummified

carcass lying at the lower edge of one of the small glaciers at an altitude of 14,500 feet has been reported by several mountaineering expeditions on Mount Kenia. The skull of a very large bull is in the National Museum, collected by Doctor Mearns at the upper limits of the Kenia forest at 10,000 feet. At the present time, however, the buffalo is known to occur only in the lower edge of the Kenia forest, and the two high mountain records, no doubt, represent strays which wandered far beyond their normal habitat and perished.

Nile Buffalo

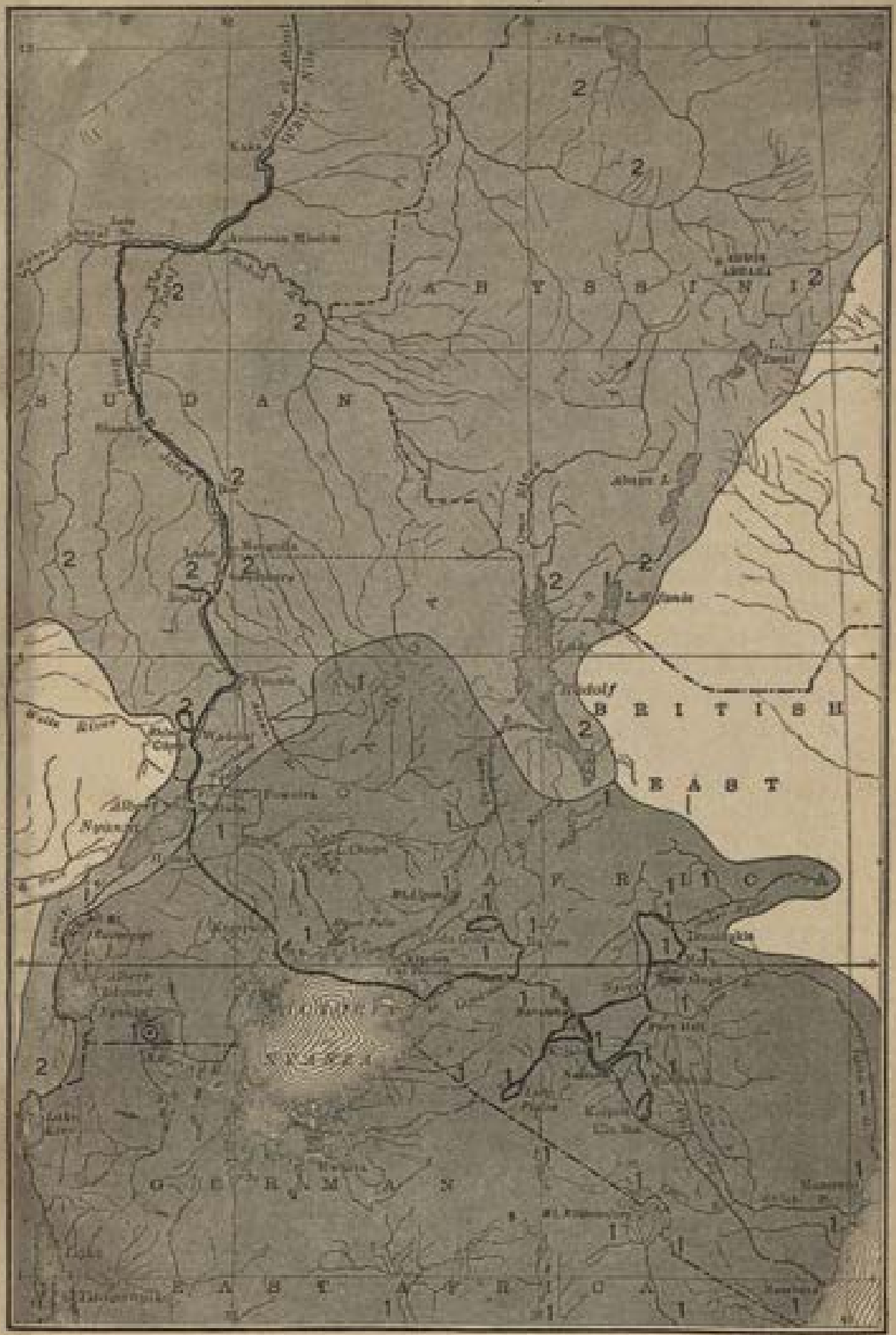
Syncerus caffer æquinoctialis

Native Names: Dinka, *anyarr;* Aluru, *jobi;* Bari, *makorr.*
Bubalus caffer æquinoctialis Blyth, 1866, Proc. Zool. Soc., p. 371, fig. 2.

Range.—From Lake Kivu northward along the Nile lowlands to the Bahr el Ghazal and Abyssinia; eastward as far as Lake Rudolf and the Rift Valley of Abyssinia.

The early explorers and naturalists who met with this buffalo in Abyssinia and the upper Nile considered it identical with the South African, owing, no doubt, to its close similarity in size and coloration. The decided horn differences were, however, detected in 1866 by Blyth, who named the race from a specimen collected by Consul Petherick on the White Nile. Von Heuglin, Schweinfurth, Baker, and Emin have given full accounts of their experiences with the buffalo of the upper Nile in the narrative of their journeys. Lydekker has described, under the name of *mathewsi*, a specimen of this race from the region lying between Lake Kivu and the Edward Nyanza. This specimen marks the extreme southern limits of the Nile buffalo.

The Nile buffalo is distinguishable from the East African by its more horizontally directed horns, which never curve downward below the level of the floor of the skull. This difference in amount of downward curvature is well shown by the skull when placed on a level surface, in which position it rests on the floor of the skull, the horns hanging free of the surface, an inch or two above it. Skulls of the East African race placed similarly rest upon the lower curve of the horns, the floor of the skull being raised several inches



MAP 11—DISTRIBUTION OF THE RACES OF THE AFRICAN BUFFALO

1 *Syncerus cafer radcliffei* 2 *Syncerus cafer aequinoctialis*

above the surface. The horns are also smaller and less wide-spread. The very largest only reach 40 inches, an average horn spread being but 32 inches. In size and shape they closely resemble the horns of the cow of the East African race. A single specimen is in the National Museum, a bull shot by Colonel Roosevelt near Rhino Camp, in the Lado Enclave. This specimen is quite equal in body and skull measurements to the East African ones. The flesh measurements were: head and body, 110 inches; tail, 28 inches; hind foot, 24 inches; ear, 10¾ inches. Basal length of skull, 19¾ inches; zygomatic breadth, 9 inches. Maximum horn spread, 31¾ inches; length along inside curve, 25 inches; width of palm, straight, 8¼ inches. Specimens have been recorded by Powell-Cotton in the upper Hawash Valley and the central plateau region of Abyssinia, near Lake Tana. Buffalo have been shot and recorded by sportsmen frequently along both banks of the upper Nile, from Wadelai southward to the Sobat River. A specimen shot by Paul Niedieck in this district has a horn spread of 44 inches, which is 3 inches in excess of the previous known record for the race.

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Roosevelt, Theodore.
Life histories of African game animals. v. 1. 1915

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